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ORIGINAL COMMUNICATIONS.

ART. I. *On combining Utility with Beauty in Architecture, and preserving Consistency in the Decorations.* By CANDIDUS.

WERE utility the paramount principle in architecture, it ought to follow that we should be most forcibly impressed by it when it presented itself directly and undisguisedly. A mere post would have quite as strong a claim to our admiration as the most elegant column; and the naked square pillars in the front of Drury Lane Theatre would satisfy the eye no less than those introduced in the east portico of St. George's Hospital. The truth is, utility will go but a little way indeed towards accounting for the delight we receive from architecture; inasmuch as it is generally least apparent, and, in fact, hardly to be found at all, in those buildings which most forcibly command our admiration. What particular utility, at least in the ordinary meaning of the word, is to be discovered in the stupendous pyramid, in the lofty spire, or in the majestic dome? Even a regard to proportions alone, upon which such stress is usually laid, frequently carries the architect quite out of sight of utility; not that exactness in the proportions is at all prejudicial to what is necessary, but because it does far more than utility demands. Most undoubtedly, beauty, and the embellishment which contributes to it, ought invariably to originate, however remotely, in some principle of utility; and, certainly, never to be in opposition to it. Adscititious ornaments there may and must be; yet these should be as the hues of the plumage, that delight the eye, although they in nowise accelerate the swiftness of the pinion they adorn. Let the style be what it may, this is a fundamental principle; not, indeed, always kept in view, yet not to be disregarded with impunity. As, in Grecian architecture, the roof and internal ceiling, doors and doorcases, were, similarly to columns, made to contribute to the ornamental character of the whole structure; so, in the Gothic, doorways and windows, gables and chimneys, buttresses and parapets, were all rendered subservient to the same purpose:

thus was beauty not merely added to, but incorporated with, utility. Both were equally obvious; yet it was their being combined that gave them an artistical value: which value, be it observed, is mainly attributable to the former quality; since, apart from that, the other would excite no emotion beyond simple approbation.

Of Grecian architecture we have scarcely any examples save temples; and these were so much alike, so simple in their plan, and had so very few features except those we have just alluded to, that they offer no express studies for numberless other things the modern architect has occasion for. It can, nevertheless, hardly be questioned, that the Greek artists would have embellished, appropriately with all the rest, whatever they might have been obliged to introduce. Had they had chimneys, these would, no doubt, have been decorated no less elegantly than their *antefixæ*, or eaves tiles; had they been acquainted with the use of glazed windows, these, again, would, in all probability, have assumed as much importance, and displayed as much inventive taste, as those of the Gothic style do. Instead, however, of studying how we might best supply, for ourselves, all those things for which we meet with no prototype, or authority, in ancient architecture, we moderns have directed our attention too much to the orders; too much, because too exclusively. With all our study, too, of this kind, we have, for the most part, quite overlooked the spirit even of the orders themselves. It would be easy to point out buildings with Doric, Ionic, or Corithian columns, as may be, which yet do not partake, even in the slightest degree, of these respective styles. In many Italian buildings, what is, by courtesy, termed the order, is the least distinctive feature; while, in many of our own, the columns and their entablature present only a ridiculous contrast to the rest of the structure. Architects, in sooth, seem to be rather a superstitious race, putting their faith in columns as certain charms against all defects and enormities. After overloading our buildings with uncouth vagaries, and antic distortions, in stone, as if ambitious of exhibiting all the grimaces of which art is capable, we next struck into a path directly opposite to this, yet as remote as before from correct taste. Calling nakedness simplicity, and meanness economy, we stripped away every thing but columns and pilasters; a system which both simplicity and economy must equally condemn. If we understand the former term at all, it implies, indeed, a certain sobriety of embellishment; but, more than all, that perfect agreement of every part, which convinces the beholder that one predominating principle regulates the whole. What simplicity, then, can there be in a structure exhibiting, at the same time, such dissimilar characters as those of a plain sash-windowed house,

and a Grecian temple? Of such absurd contradictions there are but too many grossly offensive examples here at home; but we prefer instancing that of the Post-Office at Dublin, which has a hexastyle Ionic portico, with fluted columns and an enriched frieze, attached to a plain front of three stories. How such things can be reconciled with any notion of economy is to us perfectly inexplicable; since all the extraneous embellishment is quite thrown away; while the nakedness of the other parts, excusable only where economy is consistently adhered to, becomes, when contrasted with the ornamented part, a positive and most disgraceful defect.

Architects who have given into this vice, for such we cannot help considering it to be, seem to think that, by bestowing greater finish on the order so introduced, they redeem the poverty of the rest; while, in reality, they only render it more intolerable. The greater the pretension exhibited in one respect, the more does it require to be kept up consistently throughout; and such a mixture of poverty and finery is like a fine head-dress, decorated with jewels and feathers, and worn with a *toilette de nuit*. Windows, without architraves or mouldings of some sort, are but mere unfinished apertures in a wall, without the least regard to architectural beauty; consequently, to employ such features along with finished columns, is no less a violation of decorum than to omit the capitals and bases of the columns themselves. Our advice to the architect would be: If you cannot be consistent in decoration, at least be consistent in the omission of it, and do not seem even to aim at what you can only imperfectly accomplish. If circumstances prevent your producing a finished picture, do not work up parts here and there, while others are merely sketched in: in a word, attend to *keeping*.

Architects are apt to drag in columns too decidedly; frequently, it should seem, with no other view than to save themselves the trouble of all farther thought; relying, exclusively, upon them, for that degree of character and effect they know not how else to obtain. Instead of studying how to make every other part accord with these in expression, so that the style should still be perfectly recognisable were the columns removed, they get over the difficulty altogether (and a difficulty it is of no small magnitude) merely by evading it. Columns, and the other parts of an order, are, with us, nearly altogether matters of mere routine; certainly far more so than is either desirable or necessary; consequently, they exhibit nothing of the architect's own, beyond the taste shown in the selection. Of his actual ability, of his inventive talent, we can judge only by the entire composition, and by such ideas in it as are unborrowed. The veriest bungler can hardly fail of producing some

sort of effect by means of columns. The question, then, is, not whether there is any tolerable effect at all, but whether the utmost is made of it. Whether, instead of any portion of it being lowered, or destroyed, by other circumstances, every thing else tends to heighten, and to impart an additional value to, those features. Unless he can accomplish this, or, at least, preserve some tolerable consistency throughout, the architect (artist we cannot term him) only displays his own imbecility, his utter want of feeling, and sterility of conception. While such plodding drudges degrade, by tasteless misapplication, the beautiful forms they borrow, the man of genius knows how to ennoble what he finds mean, and to elicit hitherto undiscovered beauties in what he borrows from the common stock of his art. With him an architectural composition is a picture, wherein nothing, however subordinate it may be in itself, will be carelessly passed over; but in which every thing will be studied with reference to the whole.

ART. II. *On Artisans.* From the French of QUATREMÈRE DE QUINCY. By P.

ARTISAN is a name given to one who professes a mechanical art. "Nothing can, apparently, be more absurd," says Marmontel, "than ennobling the ornamental arts to the exclusion of those of actual necessity; or making a distinction, in the same art, between the agreeable and the useful, to honour the one in preference to the other; and yet, nevertheless, nothing is more reasonable than these distinctions, when we regard them closely. The principal object of a reward is to encourage labour. So, those labours which only require common faculties, such as bodily strength, a skilful hand, quickness of perception, and a degree of industry which is easily acquired by exercise and habit, demand no higher an excitement than that of a good salary to call them forth. Robust, laborious, active, and skilful craftsmen, are every where to be found, who are perfectly contented to work for their maintenance, and whose desires extend no farther than to be able to live in comfort by their labour. In the exercise of the mechanical arts, even those which are the most useful and necessary, nothing more than the perspective of an easy and comfortable life can be presented; and the natural qualities which are essential to an artisan are not such as are likely to render their possessor more ambitious. The mind of an artisan, or a labourer, feeds not on chimeras; and fame, which exists but in the opinion of the world, can have, for him, only a feeble interest."

However true these reflections may be in the present state of

society, we must confess that the low state of estimation in which the mechanical arts are now held depends more upon those who practise them, than on any qualities inherent in the arts themselves. It is true, also, that a great difference of opinion exists as to the degree of knowledge required in those who practise the mechanical arts; and that, while some persons maintain that an artisan should confine himself to practising his craft in the manner others have done before him, without thinking of the theory of the art, or daring to strike out a plan for himself, it will be in vain to hope for much improvement. Artisans are, generally speaking, too dependent on their employers, to act otherwise than as they think most likely to please; and thus, by depressing themselves, they contribute to lower the standard by which they are judged. The reverse ought to be the case: if every man contrived to raise himself a little above the usual standard, his profession would rise with him, and would soon be held in a much higher degree of estimation. Every man, in short, when he deserves to be respected, communicates to his profession a degree of consequence which cannot fail, in the end, to be advantageous to himself. The artisans of Rome were citizens, and voted in the *comitia*; and the Greeks appear to have made still fewer distinctions than the Romans, between the liberal and the mechanical arts, and between artists and artisans. In Greece, every artisan who excelled in his calling could look forward to his name being immortalised, as well as that of the most distinguished artist. We have handed down to us the name of Architeles, a famous stone-cutter, who distinguished himself in the art of hewing out columns: and in the Isle of Naxos statues were erected to Bizas, who first formed the Pentelicus marble tiles to cover buildings. The names of several other artisans, of different kinds, have also reached us; and many works, and modes of working, now practised, have taken their names from that of the workman who invented or perfected them.

ART. III. *Experimental Essays on the Principles of Construction in Arches, Piers, Buttresses, &c.* By WILLIAM BLAND, Esq., Jun. Essay 1. *Arches.*

THE Principles of Arches. — Being fond of architecture, particularly that branch of it which relates to bridges and cathedrals, I have been induced to investigate the principles by which such stupendous, beautiful, and lasting fabrics were, and still are, constructed. I have examined the pages of Hutton, Atwood, Ware, the Encyclopædias, and others, on my favourite subject; but, failing in my object, after a careful perusal of them, I was neces-

sitated to investigate for myself. I have done so, and this and the following essays contain the result of my enquiries, which I humbly and respectfully lay before the public, in order that it may judge of their accuracy; and, also, to afford an interest to those persons who are of a corresponding taste with myself.

My first step was to cut out a quantity of wooden bricks for voussoirs, or arch stones, 4 in. long, 2½ in. deep, and 2 in. thick, sufficient in number to construct two semicircular arches; one of 10 in. span, the other of 24 in. Besides these, I cut out about 300 wooden bricks, 4 in. long, 2 in. wide, and 1 in. thick. With these materials, and without cement, I was enabled to erect arches of various forms and dimensions; but, still, a knowledge of the true principles on which they should be constructed continued to elude me, and to remain unknown. I, however, discovered that all arches, of whatever form they might be, were subject to the laws of two distinct forces; namely, one acting perpendicularly downwards, and the other horizontally outwards. This being the case, I determined to ascertain, as accurately as I could, by means of weights, the exact proportion in which these two forces acted upon every voussoir throughout an entire semicircular arch, and for this purpose I had recourse to the following plan.

I constructed a frame, as represented by *fig.* 8., the form of an oblong parallelogram (*a b*), and placed it on the edge of a table

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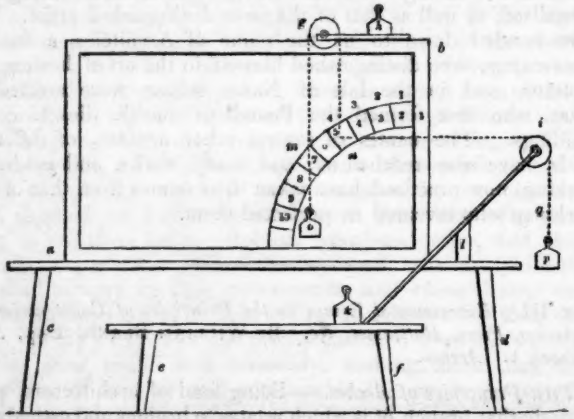
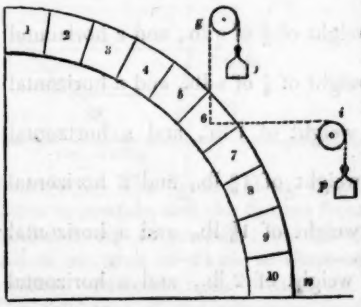


(*c d*), under which was a stool (*e f*). Two movable pulleys were attached to the frame; one at the top at *g*, which was kept in its place by the weight *h*; and the other (*i*) resting on one end of the stool, and having a weight (*k*) to prevent it from slipping; with the support *l*, at *d*, to raise or depress it at pleasure. A

proportion of an arch of the semicircular form, to be experimented upon, is represented at *m n*, and consists of ten voussoirs; the fourth of which (*n*) is in the act of trial, and has the perpendicular force of the voussoirs 1, 2, 3, balanced by the weight *o*, which is attached to the line *m g n*, running over the pulley *g*; and the horizontal force of the same voussoirs is balanced by the weight *p*, attached to the line *g i n*, running over the pulley *i*. The fourth voussoir itself is considered as having no weight in these trials, because it just counteracts the weight of the scales and lines.

With this apparatus I succeeded in the measurement of the perpendicular and horizontal forces; in consequence of which I put the voussoirs to every kind of test, and found that a corresponding law takes place throughout, relative to these two forces, which led me easily to construct a curve above that of the semicircular curve, commonly called the extrados, to represent the lateral or horizontal forces proportional to each respective voussoir, throughout the whole of the arch of the semicircular form. The perpendicular forces, being resisted by the foundation on which every arch must stand, need not be taken into consideration in the construction of the curve; but these perpendicular forces, which are proportional to each and every voussoir, can be represented better in a diagram without a curve; by which means the diagonal lines can be drawn to exhibit the proportions of the compound of the two forces, the perpendicular and horizontal, on every part of the semicircular arch. The following are the results of my experiments:—

9



Experiment First, made with only half of the arch, consisting of ten voussoirs. Let *m n* (*fig.* 9.) be the half of the arch, and constructed of ten voussoirs, from 1 to 10; and *g*, the perpendicular pulley, with the string and weight *o*; *i*, the horizontal pulley, with the string and weight *p*: the following are the results, beginning with No. 1., and descending to No. 10., taking away each voussoir after ascertaining the two forces.

No. 1. has a perpendicular pressure of $\frac{1}{2}$ of a lb., and a horizontal pressure of $\frac{3}{4}$ of a pound.

No. 2. has a perpendicular pressure of $\frac{1}{8}$ of a lb., and a horizontal weight, or pressure, of $\frac{1}{16}$ of a lb.

No. 3. has no perpendicular pressure, but $\frac{1}{8}$ of a lb. of horizontal weight.

No. 4. has no perpendicular pressure, but $\frac{1}{4}$ of a lb. of horizontal weight.

No. 5. has no perpendicular pressure, but is sustained by a horizontal force of $\frac{1}{8}$ of a lb.

Experiment Second, made with the whole semicircular arch, consisting of twenty voussoirs. Let *a b c* (*fig.* 10.) be the arch;

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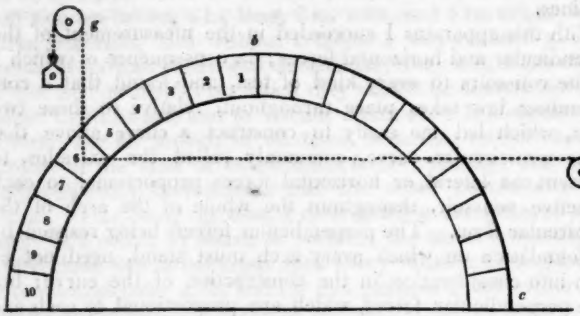


g and *o*, the pulley and weight to measure the perpendicular force; and *i p*, the pulley and weight to measure the horizontal force. In this experiment the voussoir No. 1. was placed against the part of the arch *b c*, as represented in the diagram, and the two forces then measured; the voussoir No. 2. against No. 1. and *b c*; and so on to No. 10. The results are as follows: —

No. 1. has a perpendicular weight of $\frac{1}{2}$ of a lb., and a horizontal force of $1\frac{1}{8}$ lb.

No. 2. has a perpendicular weight of $\frac{3}{4}$ of a lb., and a horizontal force of $1\frac{1}{2}$ lb.

No. 3. has a perpendicular weight of 1 lb., and a horizontal force of $1\frac{5}{8}$ lb.

No. 4. has a perpendicular weight of $1\frac{3}{8}$ lb., and a horizontal force of $1\frac{5}{8}$ lb.

No. 5. has a perpendicular weight of $1\frac{5}{8}$ lb., and a horizontal force of $1\frac{3}{4}$ lb.

No. 6. has a perpendicular weight of 2 lb., and a horizontal force of $1\frac{7}{8}$ lb.

No. 7. has a perpendicular weight of $2\frac{1}{8}$ lb., and a horizontal force of $2\frac{1}{8}$ lb.

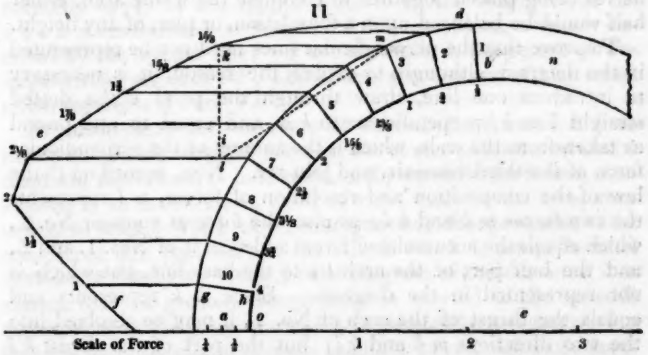
No. 8. has a perpendicular weight of $3\frac{1}{8}$ lb., and a horizontal force of 2 lb.

No. 9. has a perpendicular weight of $3\frac{3}{4}$ lb., and a horizontal force of $1\frac{1}{2}$ lb.

No. 10. has a perpendicular weight of 4 lb., and a horizontal force of 1 lb.

By this scale of proportions belonging to experiment second, it is seen, that the perpendicular weight, or force, increases as the weight is added; but the lateral weight, or horizontal force, increases only as far as the seventh voussoir, and then decreases. From this scale, a curve, called the extradas, may be drawn above a semicircular arch, which will exhibit pretty correctly the proportions of the lateral, or horizontal, force of every voussoir composing the arch. With regard to the perpendicular forces, it may be remarked, that, as they are resisted by the ground, or foundation, it is unnecessary to introduce them here. In fact, if diagonal lines be drawn, equalling the respective perpendicular and horizontal forces of every voussoir, each diagonal line would again be resolved into the above two horizontal and perpendicular forces, of which the one representing the latter would be omitted, in consequence of its having no tendency whatever to press outwards: but more of this hereafter.

In order to illustrate this particular relative to the extrados, let *fig.* 11. be a diagram, in which they are represented by the



lines *d e f*. The figures along those lines show the horizontal forces in pounds, and the figures from *a* to *b* denote the perpendicular forces in pounds. In this diagram, *a b* represents one half of an arch of 24 in. in diameter, and constructed of ten wooden voussoirs upon which the experiments were made. The thickness of the voussoirs, from *g* to *h*, is 2½ in.; and, as each voussoir weighs half a pound, I have taken the thickness of them as my scale for half a pound, which scale is divided into eighths, quarters, halves, and whole pounds. To the adoption of this scale for half a pound I think there can be no possible objection, because, if the voussoirs were of stone instead of wood, or even of iron, this line would represent certain weights within

the extrados. This being the case, the ten parallel and horizontal lines, contained within *d e f*, represent correctly the proportions of the horizontal forces acting on each of the surfaces of the ten voussoirs, numbered from 1. to 10. A line then drawn, passing through the outer extremities of the lines representing the horizontal forces, becomes the extrados to the arch of a semicircle. The figures at the end of each parallel line on the extrados denote the weights, or forces, of equilibrium outwards; and the figures under the intrados are the weights, or forces, of the equilibrium perpendicularly downwards, for each of the ten voussoirs, but the lines are not drawn.

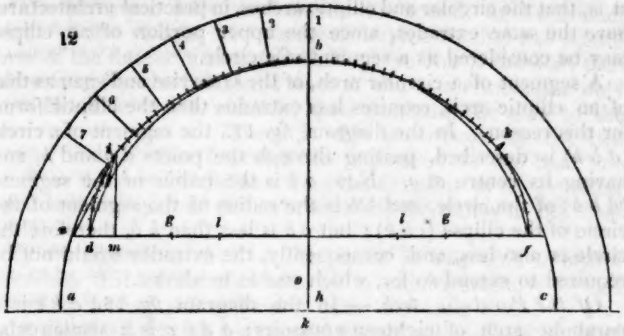
The point *i* is the centre of gravity of the quadrant and extrados, or of the whole body comprehended within the extrados and intrados *o f e d*, which was ascertained by a model; in fact, by a piece of paper cut in the exact form of the diagram. Indeed, supposing the mass to be of a uniform thickness, and of the same specific gravity, a model of wood, stone, metal, or even of paper, will give the same precise result, and this model would just be balanced firmly on the base line, *f o*; consequently, the other half of the arch would be balanced the same; and both halves being placed together to complete the whole arch, either half would be balanced upon a foundation, or pier, of any height.

To prove that the perpendicular lines need not be represented in the diagram, although, to explain the reason, it is necessary to introduce one line, draw through the point *k* the dotted straight line *k l* perpendicular to *k m*, and equal to one pound as taken from the scale, which is the amount of the perpendicular force of the third voussoir, and join *m l*. Now, according to the law of the composition and resolution of forces, *m l* represents the two forces *m k* and *k l*; as also the force at voussoir No. 3., which equals the accumulated forces added to it of Nos. 1. and 2., and the half part of the arch *l n* to the base line, but which is not represented in the diagram. Since *m k* represents and equals the thrust of the arch at No. 3., it may be resolved into the two directions *m k* and *k l*; but the part of the thrust *k l* acts perpendicularly downwards, and, therefore, has no tendency to overthrow the arch. The part of the thrust *m k*, however, acts horizontally outwards, and, consequently, is the only overturning force of the arch at voussoir No. 3.; therefore, the only part of the force *m l* which need be considered: the same may be shown of all the other horizontal lines in the diagram. On a reinspection of the diagram, it will be seen, that the average distance from the extrados to the intrados, measured horizontally, equals half the span of the arch, or *o* to *c*, which is the radius of its circle.

Thus far with regard to the circular curve; and, since arches are constructed of other forms, derived from curves called the

conic sections, &c., such as the ellipse, the parabolic and the hyperbolic, the cycloid and the catenarian forms,

First, of the Elliptic Curve and Arch. — This curve, in its construction, approaches so near to the segments of two circular curves, as may be seen seen by *fig.* 12., that the law of the hori-



zontal and perpendicular forces in the circular curve will almost correctly apply to the elliptic form. In the diagram *fig.* 12. *a b c* is a semicircular arch, and *d b f* is an ellipse, which is denoted by the dotted line; *g g* are the foci: *h*, the centre of the large circle segment *i k;* and *l l* are the centres of the small circle segments *d i* and *f k*.

In consequence of the part of the elliptic curve *i b k* so nearly coinciding with the curve of the circle, as instanced in the diagram, the lateral, or horizontal, and perpendicular forces, considered in an architectural point of view, must be the same very nearly in both. With this being granted, there remains to be considered that part only of the ellipse which is comprehended between *d i* and *f k*. Now, in the diagram of the extrados, it is shown, that the greatest lateral force is exerted at the seventh voussoir, or at the points *i* and *k;* consequently, a counteracting buttress must be placed at these points to preserve the structure. In the first experiment with the voussoirs, it is shown, that the four bottom voussoirs have no apparent lateral force, when the voussoirs above them have been removed; therefore, when buttresses are applied at the points *i* and *k*, or the extrados completed to counteract the outward and horizontal forces of the voussoirs above, the lowest four voussoirs on each side of the circular arch perform only the part of piers.

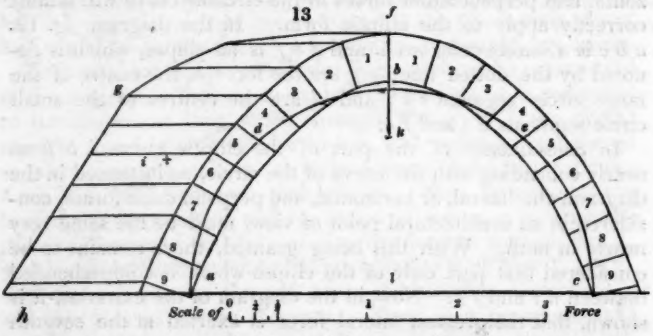
Since piers are for the purpose of supporting perpendicular pressure, the nearer their line approaches to the perpendicular, the more efficient they will become.

In the case before us, from the point *i* draw *i m* perpendicular to *d f*, and join *i d* and *i n*. The part *m d* of the line *m n* is

less than (*m n*) the whole line; therefore the line *i d* is nearer to *i m* than to *i n*; consequently, the voussoirs of the elliptic arch between *i d* and *f k*, when those above them have their requisite abutments, become, indeed, more efficient as piers than even those of the circular arch. The conclusion we then arrive at is, that the circular and elliptic arches, in practical architecture, have the same extrades, since the upper portion of an ellipse may be considered as a segment of a circle.

A segment of a circular arch, of the same rise and span as that of an elliptic arch, requires less extrados than the elliptic form, for this reason. In the diagram *fig.* 11., the segment of a circle (*d b h*) is described, passing through the points *d b* and *h*, and having its centre at *o*. Now, *o b* is the radius of the segment (*d b h*) of the circle, and *h b* is the radius of the segment of the circle of the ellipse (*i b k*); but *o b* is less than *h b*, therefore the circle is also less, and, consequently, the extrados would not be required to extend so far, which was to be shown.

Of the Parabolic Arch. — In the diagram *fig.* 13., *a b c* is a parabolic arch of eighteen voussoirs; *a d b c* is a semicircular



curve of the same span; *f g h* are the extrados to half of the parabola, from *a* to *b*; *i* is the centre of gravity; and *k* is the forces of the parabola. In the experiment with this form of arch, the following are the results of the forces of the voussoirs, beginning with the first voussoir at *b*, and ending with the ninth voussoir at *a*: —

No. 1. has a perpendicular weight of $\frac{5}{8}$ of a lb., and a horizontal force of $1\frac{1}{2}$ lb.

No. 2. has a perpendicular weight of 1 lb., and a horizontal force of $1\frac{3}{4}$ lb.

No. 3. has a perpendicular weight of $1\frac{3}{8}$ lb., and a horizontal force of $1\frac{7}{8}$ lb.

No. 4. has a perpendicular weight of $1\frac{5}{8}$ lb.

No. 5. has a perpendicular weight of $2\frac{1}{8}$ lb.

No. 6. has a perpendicular weight of $2\frac{3}{4}$ lb.
No. 7. has a perpendicular weight of 3 lb.
No. 8. has a perpendicular weight of $3\frac{3}{8}$ lb.
No. 9. has a perpendicular weight of $3\frac{7}{8}$ lb.; and the horizontal force of each voussoir, from No. 4. to No. 9., is $1\frac{7}{8}$ lb.

The principal difference between the lateral, or horizontal, forces of the circular and parabolic curves is, that the lateral force of the former increases from No. 1. to No. 7. voussoir, then decreases; but the horizontal force of the latter increases only from No. 1. to No. 3. voussoir, then continues the same to the last voussoir, No. 9. There is this accordance in the two curves, namely, that lateral forces measured on the base line (*a e*), or the average distance from the extrados to the intrados, equal half the span of the arch, which is the radius of the same circle.

Of the Hyperbolic Arch. — The curve of this arch so nearly resembles that of the parabola, as to require similarly formed extrados, having this difference, that the base *h a* (*fig.* 13.) must equal *a l*, having *h g* parallel with the hyperbola as high as *f*. Arches being rarely, if ever, built after the manner of this curve, it will be useless to go any farther into its qualities.

Of the Cycloidal Arch. — In the diagram *fig.* 14. are drawn

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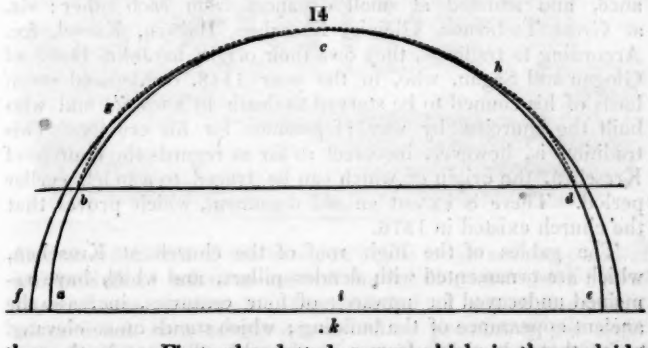

three curves. First, the dotted curve, which is the cycloid; second, the semicircular arch (*a b c d e*) passing through the three points *b*, *c*, and *d* of the cycloid, and having its centre at *i*; and the third is also a semicircular arch (*f g i c h*), having its centre at *k*, which coincides with the cycloid almost to the two points *b* and *d*; but near these points the cycloid partakes more of the ellipse, by falling within the circular curve from *g* to *b*. It may be safely inferred, from these circumstances, that an arch constructed of masonry, of the cycloidal form, would require its extrados, from *c* to *g*, to be equal to the extrados of the large semicircle, *f g c h*.

Of the Catenarian Arch. — In consequence of the close similarity between the catenarian curve and the parabolic, there cannot exist a doubt but that, in all structures, the same extrados will effectually answer for both.

During the consideration of the extrados to the circular and other curves, the effects of friction were not allowed for, since the voussoirs, throughout the experiments, were suspended in the air by the two lines, the perpendicular and the horizontal, with the balancing weights attached to each. The only friction which can be named arose from the axes of the pulleys and the bending of the lines.

ART. IV. *Description of the Church at Kraschen, with some Remarks on the Church Architecture of the Middle Ages.* By M. RIEMANN, Royal Inspector of Buildings at Wohlau in Silesia. Translated from Crelle's *Journal der Baukunst*, bd. 7. hft. 1. p. 89.

THE Catholic church at Kraschen, which is situated a mile and a half (German) from the city of Guhran, was built in the fourteenth century. It is constructed of burnt unpolished tiles, and is distinguished for its pleasing form. In this part of Silesia there are seven Catholic churches, all pretty much alike in appearance, and situated at small distances from each other; viz. at Great Tschirnau, Gleinig, Kraschen, Rabsen, Kantel, &c. According to tradition, they owe their origin to John Duke of Glogau and Sagan, who, in the year 1448, condemned seven lords of his council to be starved to death in a tower, and who built the churches by way of penance for his cruelty. This tradition is, however, incorrect as far as regards the church of Kraschen, the origin of which can be traced to a much earlier period. There is extant an old document, which proves that the church existed in 1376.

The gables of the high roof of the church at Kraschen, which are ornamented with slender pillars, and which have remained undecayed for upwards of four centuries, increase the ancient appearance of the building; which stands on so elevated a site, that it is visible from a considerable distance in the surrounding country. Two sketches of the external aspect of this church (*figs.* 15, 16.), and *fig.* 17., which represents the timber framework of the roof (Dachstuhl), will help to elucidate this brief description.

Though extremely plain and simple, the church at Kraschen is, nevertheless, very beautiful. It has a tower 110 ft. high, and 18 ft. broad. The slender buttress-like pillars, which ornament the gables, are 2 ft. thick, and are constructed of small-sized common tiles: they are of a hexagonal form, narrowing towards the top, where they terminate in small pediments. The

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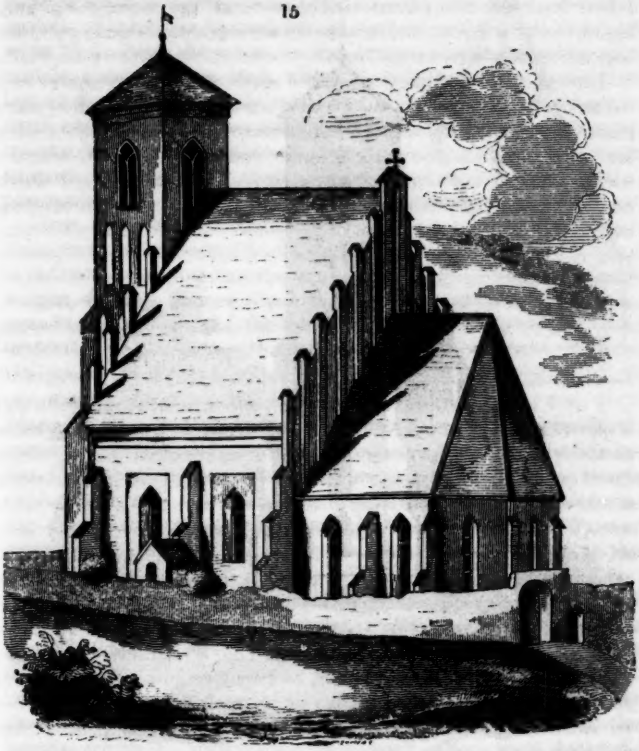

Gothic ornaments of the windows in the tower are composed of common tiles; and in no part of the building are there any of those elaborate ornaments, formed either of sandstone or terra-cotta, which are generally considered as peculiar to the architecture of the middle ages.

The lofty roof, the height of which far exceeds the limits of proportion, is supported by rafters 48 ft. long. Roofs of this description are usually considered as characteristic of the architecture of the middle ages; though the reason of their being of so very high a pitch has never been satisfactorily explained. The boldness of the architects who constructed Gothic arches resting on slender pillars, excites surprise; but these roofs, which date from about the same period, are still more astonishing. The present mode of forming a roof was not then known, but was first employed in the seventeenth century. Many old churches have their roofs supported by timber frames (Dachstuhl)

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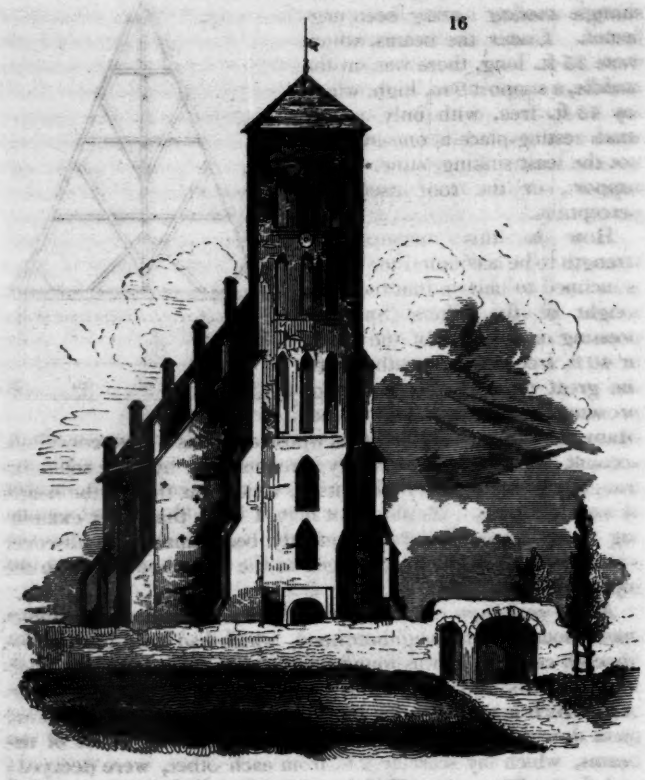
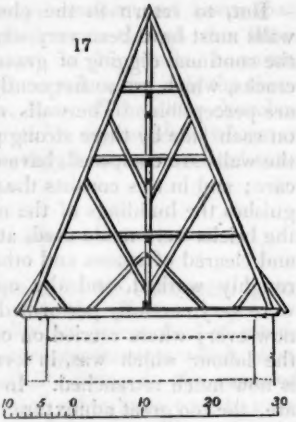


nearly resembling that of the church at Kraschen. The beams are 30 ft. or 40 ft. long, and without support, either from above or below. Over the middle of these beams there usually lies a supporting beam (Trägerbalken), which is not fixed to the beams by iron screws, or fastenings of any kind; and which, instead of preventing their sinking, seems more likely to be a weight upon them. All the other roof fastenings, however closely they might be united, and riveted together, by the crossing of the strap with the collar-beams, &c., seem calculated to produce a pressure on the middle of the beams, rather than, like the hanging beam, to support them in that part. As to screws, cramps, braces, holdfasts, or iron-work of any kind, to give strength to the connecting members, there are none whatever to be found in these roof-frames.

During the present year I took down a roof-frame (Dachstuhl), similar to that represented by *fig.* 17., which had decayed in

consequence of the repairs of the shingle roofing having been neglected. Under the beams, which were 35 ft. long, there was, in the middle, a support 9 in. high, which lay 43 ft. free, with only a very small resting-place at one end; yet not the least sinking, either of the support, or the roof itself, was perceptible.



How is this inconceivable strength to be accounted for? One is inclined to believe that the great weight of the rafters (Sparren) pressing on the ends of the 30 ft. or 40 ft. free beams, together with the great mass of roof covering, prevents the sinking in the middle. Many old experienced builders, whose opinions I have consulted, account for this extraordinary circumstance by the solid infrangible fibres of the timber itself, which was that of the hearts of very old trees. Be this as it may, I know that, after examining these beams, I have frequently been unable to discover which end of the timber belonged to the stem, and which to the top, of the tree.

A few years ago, in the course of some alterations in a nobleman's house in this neighbourhood, which had been built in the fifteenth century, it was found necessary to take down the roof-frame (Dachstuhl); but it was proposed to make use of the timbers, which appeared to be in a perfectly sound state; on taking them down, however, it was discovered that the heads of the beams, which lay scarcely 2 ft. from each other, were decayed; and the roof, over one of the apartments, had been prevented from falling in only by the firmly fixed laths (Stockholzer).

These circumstances prove the necessity of directing particular attention to the condition of old timbers and roof-frames, which are frequently in a decayed or insecure state. It is certain, that the necessary repairs in church roofs are frequently totally neglected, or long delayed; because the inconvenience of such neglect and delay is not so sensibly felt as it would be in dwelling-houses. The darkness within the roofs of churches, which are not lighted by windows of any kind, renders, indeed, every crack that may make its appearance in the roof plainly visible; but the signs of decay which present themselves in the beams and roof-frame are, for the same reason, unseen.*

* Several years ago, the falling of a heavy bell in this neighbourhood occasioned the governor of Breslau to issue an order for examining the security of

But, to return to the church at Kraschen: its foundation walls must have been very strongly built; for, notwithstanding the continual digging of graves close against them, none of the cracks, which are so frequently found in old church foundations, are perceptible. The walls are 3 ft. thick, and are supported on each side by three strong pillars. The burnt tiles, of which the walls are composed, have evidently been prepared with great care; and in this consists the peculiar superiority, which distinguishes the buildings of the middle ages. The earth of which the bricks were made used, at that time, to be properly washed, and cleared of stones and other foreign substances: it was thoroughly worked, and the operations of framing and burning were very carefully performed. The manufacture of bricks is now every where carried on on a penurious scale; at all events, the labour which was, in former times, devoted to the business is now much retrenched. In my opinion, the principal faults are, the too great admixture of sand (which is put in to lighten the labour of working the brick-earth), and the employment of earth which is not sufficiently hard, or, more properly speaking, too watery, which facilitates the framing. These faults are attributable to the scanty payment now given for the labour. It may easily be imagined, that, when 1000 bricks are made for less than two rixdollars, the work cannot be very carefully executed.

The great roof of the Kraschen church is covered on each side with 48 rows of pantiles; and, owing to the steep form of the roof-frame (see *fig.* 17.), this enormous weight presses on the extremities of the beams; which, unless they warp, cannot sink in the middle. The binding of the roof likewise prevents the bending of the rafters, and enables it thus to resist the attacks of the boisterous winds to which the church, owing to its high situation, is exposed. In 1817, a large newly erected barn, which stood in a direction similar to that of this church, was completely blown down, though it had been built in a perfectly regular, and apparently secure, way.

The construction of old churches presents many inexplicable peculiarities, which would not admit of imitation, even though the same building materials could now be procured; and there are, likewise, peculiarities in their interior arrangement, the reasons for which are now unknown.

The high altar is always erected towards the east. The sacristy is never behind it, but always either on the right or left side of it; probably that the priests, on entering the church, might kneel before the high altar, according to the Catholic

bells. The accident, which was attended by some damage, was occasioned by the decay of the pin (Zapfen).

rites. The chancel is almost always smaller and lower than the nave; and it is invariably arched, even though the latter should not be so. The parish church of Neumarkt, however, forms an exception to the first of these rules; for in it the chancel is loftier than the grand nave. None of the older churches have upper choirs in addition to their organ-lofts: wherever these choirs exist in such churches, they have been erected subsequently to the original buildings.

ART. V. *Remarks on Street Architecture.* By Mr. FREDERICK LUSH.

IN walking over the city of London, no person fond of architecture can avoid observing the varied appearances which exist, sometimes, throughout a whole street, owing to the repeated alterations which have succeeded each other from time to time. One street is crowded with a variety of forms not deserving the name of an architectural composition, the proportions of which are quite irregular. The chief features in the elevation of the London street houses are those of the shop fronts, which are, generally speaking, a mass of combinations diametrically opposed to one another, and executed without any degree of taste or judgment. This practice has been followed in nearly every street that you can mention, and, unfortunately, prevails in Regent Street and Oxford Street. To prevent this, whenever the formation of a new street is projected, I would suggest that the designs of the shop fronts should be made to vary as little as possible, and that the upper member of the cornice should be continued in a straight line down the whole length of the frontage of the houses, except at intervals, where there should be a break, and a greater display of ornament introduced. As some trades and establishments require more accommodation than others, these should be placed in the centre, or most conspicuous part, of the street, and a few sculptured relievos might with propriety be added, indicative of the business of the proprietor, or a design well adapted for the site on which the premises are erected. The means of combining the houses, so as to form a continued style of architecture, or the association which one house should bear to the other, approaching to the symmetry and unity of system observed in public edifices, can only be sought for in the principal streets, or opulent districts; but, when such cases occur, we find them much deteriorated in effect by a portion of the street, or a single house, having been renovated, and looking new from fresh painting, whilst those adjoining remain untouched, presenting almost a ridiculous contrast. As

in a public building, or a private detached dwelling-house, a continued regard to uniformity is maintained; so, where a line of houses forms a mass, the same character should be preserved; because the houses, being in contiguity, bear an equal relation to each other. And, as gratifying sensations arise in viewing a regular continuation of arches from a commanding point of view, or a long range of columns, as in a Grecian temple, or down the ailes of churches; so, in a street, a succession of parts will raise the mind, by giving pleasure to the imagination. The new street commencing from the Mansion House, and terminating at London Bridge, is one of the best specimens of street architecture we have in this part of London; and, though uniformity is preserved throughout the whole, it is not carried to such an extent as to produce monotony. Every opposite house is not exactly alike: but there is no great necessity that the whole, or opposite portions, of a street should correspond in every respect, so long as the style or order is kept up. With regard to the application of the three-quarter columns, no particular fitness or utility is recognised in them; though the elevation would be deprived of a striking appendage if they were omitted, and the effect now acquired would ultimately be lost. As these columns are in connexion with the accompanying ornaments and details, and seem to perform some office, serving, also, as a means of shelter to the receding windows, they can with propriety be introduced. Semi or three-quarter columns, applied to large houses in the most public thoroughfare, when they appear to increase their magnitude, and add to the effect and beauty of the external decoration, give a certain degree of grandeur and additional force, unequalled by any of those ill-designed modillions, which, crowded together to form a substitute for columns, are usually the most inferior objects to any executed on the face of the building. The practice of adopting pilasters in the place of columns, to support a heavy projecting cornice, or scarcely any at all, is another instance quite contrary to any sound rules of principle or true fitness. Where the pilasters determine the situation of party-walls, or partitions, or where they aid to support the space contained between the openings, or perform some other useful purpose, they contribute materially to the general effect; but much of the harmony which ought to distinguish an edifice is diminished by insufficient, or ill-applied, pilasters.

Many such examples are too numerous for notice, in which absurdities are heaped one upon the other. Much of the beauty and general outline of a street consists, also, in the disposition of the windows, and in placing the entrances of each separate house in such a manner as not to appear too closely connected. Too

great a variety in the form of the apertures on the same front of a building, and their not being placed vertically one above the other, can never gratify the sight, and must dispose the spectator to entertain unfavourable opinions respecting the character of the building. Windows admit of external ornament, as they would look bare and naked without; but they should be relieved with little more than an architrave and dressings; and these and the door-cases should correspond with the columns employed, or other prominent parts.

But how often do we find the reverse of this; and how generally is the practice of introducing pilasters and semi-columns, supporting a pediment above, where they are totally inconsistent with the style and size of the building, adopted!

Many accidents take place from the corners of the streets, instead of being curved off, being left so as to form a right angle: but we will hope, now these subjects are more considered, that the method of rounding the corner houses will become general. If several streets intersect a principal one, where a greater distribution of light is required in the room, a bow window in the rotundity of every turn, on the same level with those in the front, but not to extend beyond the line of the streets of which it forms the right angle, would have the advantage of enlarging the room, and affording a better view of the adjacent town, than could otherwise be obtained. We often see the uniformity of architecture in a street destroyed by the various shapes of the roofs; and by the necessity of lengthening the chimneys of the houses at the corners, in order to prevent smoky rooms. Curved, or Mansard, roofs are best adapted for such occasions; and they have an advantage over the common roofs, as less expense is incurred in their construction, owing to the reduced quantity of brickwork: but all the roofs could be easily made of one description, either curved or hipped. The effect, which was destroyed by raising the chimney shafts at the extremities of the street, could be preserved, in a great measure, by having them of the same height as the rest, with a thin metal cap permanently affixed on the top, to prevent the downward blasts of wind, which often occur in such situations, and render the rooms smoky. In applying such a cap, there would be no occasion for a chimney-pot; and, when the flues were carried up the necessary height, the upper surface should be splayed off, so that when eddies of wind, in a steady horizontal direction, acted upon them, they would be obstructed, and rise to mix in the air again.

Charles Square, Hoxton, Nov. 27, 1835.

ART. VI. *On the ancient Buildings of England; their Foundations; their Walls of Brick and of Stone; and the Difficulty of ascertaining their Age, merely from the Material, and the Manner in which it has been used.* By R.

THERE are some remains of British masonry in England, on which traces of the chisel are discovered, which evidently show that the inhabitants of our island had a greater knowledge of the art of building than was necessary for the erection of mere huts and hovels, before the Roman invasion; and we may, therefore, naturally conclude that brick-making, which is so immediately connected with masonry, was not altogether unknown to them. Indeed, the greater number of the useful arts, which were known and invented by the inhabitants of the antediluvian world, were preserved and used by their descendants: and although, in many parts, the people who led a pastoral or hunting life lived in tents and caverns, because, from the nature of their occupation, they were obliged frequently to shift from place to place, and, therefore, neglected and lost the useful arts; yet, among those people by whom the first cities of the world were founded, all the known arts useful to mankind, and useful in society, in which the advantages of the distribution of labour were appreciated, appear to have been preserved and practised.

We cannot ascertain the precise time when Britain was first discovered, or when the discoverers made a settlement in it; but, in all probability, they were driven by chance upon the coast, and came from a country where the arts of ship-building and navigation were known, and, consequently, other useful arts. The arts being once introduced, necessity would compel their improvement, and the invention of others. An increase in the number of inhabitants would, of course, increase the quantity of land to be cultivated for sustentation; and with agriculture the art of building would make progress, as more habitations would, of necessity, be wanted. But, although the first settlers on our island, doubtless, brought some knowledge of the arts with them, they must have learned much, in this respect, from the Phœnicians, and people of other civilised nations, whom commerce had brought to their shores. They had not, however, made much progress in the art of masonry before the invasion of the Romans; and, although the Britons did not derive their first knowledge of building from these people, it must be confessed that this, like every other art, was greatly improved after the country was subjugated to, and under the influence of, the knowledge and power of the invaders: for Cæsar, on his first expedition, found that the habitations, in general, were mere huts, crowded together without any order,

or formation of streets. But, while, in these houses, which were suitable to the plain and simple manners of the inhabitants, little stone or brick could have been used, yet the existence of Stonehenge, which is considered to be a British work, and the many Druidical temples, show that they were not by any means ignorant of the art of masonry, before the time of the Romans.

The manners and customs of the ancient Britons, however, before Cæsar's first expedition, are so little known, that, with the exception of the Druidical altars, there is great uncertainty respecting the other kinds of buildings which they are said to have erected; for we cannot prove that they had any peculiar mode of working, or any particular material, which the Romans, or others subsequent to them, had never used.

The many remains of Roman buildings in this and in other countries show that they were particularly careful in laying the foundations of their walls; and the excavations were, in general, not made until a solid stratum was obtained. Where the ground was found to be soft or marshy, it was strengthened with piles of alder, or of oak, partially singed, which were driven in near to each other, and the spaces between them filled with charcoal. The tops of the piles and the charcoal being brought to a uniform level, the foundations were begun with rough stones bedded in clay. When the excavations were made, and the ground found to be solid, the foundations were laid with rough stones upon the natural soil; sometimes they were commenced with paving-stones, laid flat, and at other times set on edge, in the clay; and, occasionally, the walls were built on layers of large pebbles bedded in clay.

The foundations, therefore, of ancient buildings being laid in, and carried up with, clay, is no proof of their being British; because the Romans, in general, laid their foundations with clay, while the superstructure was cemented with mortar.

In the fifteenth century, the foundations of buildings were also laid without mortar, in a different manner from that described. The excavations being made, the bottom of the trench was rammed as firm as possible; on this was laid a stratum of sand or gravel, 8 in. thick, which was also firmly rammed; and the whole was covered with a thin coat of ashes, or lime core. This being settled, another stratum of gravel or clay, laid upon it, completed the first part of the foundation; the latter being likewise well rammed. The remaining part of the foundation was carried up to the level of the ground with rough stones bedded in clay.

As the Saxons and Normans followed the Roman methods in laying their foundations, either with or without piles, as occasion required, it is difficult to distinguish with certainty the age of a building (erected even after the Roman settlement),

either from the manner in which the foundations are laid, or from the kind of material used in them. Of course, the buildings of the ancient Britons might be distinguished, did they exist; for the builders did not, for the huts they inhabited, and which Cæsar found them in, require that strength in their foundations which the Romans found necessary for their buildings; but, although the different sorts of masonry used in Britain were introduced by the latter people, it is certain that the ancient Britons used stone, where timber was scarce, even in their huts, as door-posts and lintels, which were mortised and tenoned after the manner of the carpenter; and in their rudely sculptured monuments, altars, and temples, before the Roman invasion. When we consider the many sculptured caverns and temples which were, at this time, made and erected among the Egyptians and Phœnicians, and the traffic carried on between these people and this country, the knowledge of masonry, to a certain extent, anterior to the Romans, may be easily accounted for. From these people the Britons might either receive instruction, or be furnished with men for the erection of their works of masonry.

The Romans, it would thus appear, did not introduce the use of stone in this country; and, although they perfected masonry during their settlement, architecture was, indeed, very rude while they remained masters of the country; and it was certainly first improved by the Saxons, but more tastefully and judiciously by the Normans.

The Roman walls, in general, were built with cement, and tiles or flat stones; which latter were laid in courses, at convenient distances, to bind the parts together, and at the angles, to strengthen them. These bands consisted, occasionally, of three or four courses of stones, laid through the wall, or on the top of so much of it as was built, and they were placed at the distance of 2 ft. or 3 ft. above each other, in the manner of shelves; the intermediate spaces being filled in with a cement composed of ragstones, or of mortar and pebbles, or of such other materials as the locality conveniently afforded. There is no British work now in existence, that is, built by Britons, in this manner: but we must not thence conclude that they were ignorant of the art of making bricks or tiles before the Romans settled in the country; because a correspondence subsisted between them and the Gauls (to whom the art of making bricks was known, and by whom it was practised), and whose manners and customs they might acquire a knowledge of, as well as they did of their religion. The unbaked bricks used by the Britons, which were composed of clay and straw well mixed, and dried in the sun, were, however, differently made to the unbaked bricks of the Romans, which were suited to a hotter climate.

During the settlement of the Romans, and after their departure, bricks were only employed where other materials could not be procured to suit the intended purposes; and, therefore, they were made to supply the place of stone, in cases where the nature of the work required it, and where necessity obliged them to be used in turning arches, or in forming bands to strengthen the walls; and, from this want of proper material, the builders had frequently to use ragstones and pebbles for the greater part of their work. The Saxons, also, built, after the Roman method, with tiles and square stones; but the former were very sparingly used when the latter could be easily procured. This not only shows that the art of tile or brick making was by no means lost in Britain after the departure of the Romans; but, further, that the materials used in a building cannot determine by whom it was erected; and that some of the buildings by the Saxons and Normans might, or might *not*, have been erected out of the ruins of old Roman wails. Necessity, no doubt, obliged the Saxons and Normans to follow the plan adopted by the Romans, of making bricks to suit their purpose, where stone could not be procured.

There are two churches at St. Albans, one built by the Saxons, in the tenth century, and the other by the Normans, in the eleventh century, which are erected entirely with tiles, or bricks, of the same sort as those used by the Romans. In both of these building many tiles may have been used which were gathered from the remains of old Roman walls; but it is evident that many of them must have been new, as the forms could not be cut in the old Roman tiles, from their hardness, to suit the situations in which some of them are placed. Neither is it probable that the old Roman walls could have furnished sufficient materials for the Norman buildings; especially as their predecessors, the Saxons, would, probably, help themselves unsparingly while any that were worth taking remained. This will appear more obvious when we keep in mind that, in the Roman walls, tiles were only used for bands, and to strengthen the angles of buildings, so that the supply from them could not have been so great as may have been imagined; more especially when we consider that few old tiles could be extracted from the cement, which had, through time and the quality of its composition, become very hard. In the abbey church of St. Albans, and the church of St. Botolph's Priory in Colchester, new tiles must have been used in several parts of the work, which required to be neat and exact; and, in all the circular work, in the pillars and newels of stairs, and for those ornamental parts peculiar to Saxon and Norman buildings, bricks must have been moulded for the several purposes; while the work in these buildings is so well executed, that it must have been done by experienced work-

men, and chiefly with new materials; though the interior parts of the walls might have been filled in with old materials from the Roman remains. There are, also, many walls, in which the tiles are used in bands, in the manner of the Romans, that, when strictly examined, are found to be of Norman architecture.

It thus appears that wall tiles, or bricks, were made and used by the Saxons and Normans in their buildings, in the same form, and sometimes in the same manner, as by the Romans; and that, after these people left Britain, tiles and bricks continued to be made in the same manner until the twelfth century, or the time of Henry II.

The bricks formed during this age were not made to a standard, as at the present day. Those of the Saxons and Normans were similar in size to those made by their predecessors, and measured nearly 17½ in. long, by 11½ in. broad, and were nearly 2 in. thick; but these dimensions varied in many cases, and were guided by the nature of the earth of which they were formed, and by the purposes for which they were intended. The Romans, as well as the Saxons and Normans, had tiles moulded for various kinds of work; those for the pillars which supported the floors were, in general, circular, and about 9 in. in diameter; while those used for floors, and for covering roofs, measured 22 in. square, and upwards.

The English continued to make their tiles after the Roman manner until the beginning of the twelfth century, as before observed; at which time they began to change the form of them, and continued to do so until about the year 1320; when the extensive commerce carried on, at this time, by Flanders, led the British to acquire a knowledge of the Flemish manners and customs, and, among other things, of their mode of making bricks, the forms of which, being smaller, were much more convenient than those previously in use, and were consequently adopted. These bricks, with a slight alteration in size, were the same as those at present in use. The name of *bricks* was not, however, given to them until about the year 1480, their previous name having been wall tiles.

In the fourteenth century the wall tiles, or bricks, used in some buildings, were made after the Flemish manner, but of various sizes; some of them being 12 in. by 6 in., and by 3 in.; and others 10½ in. by 5 in., and by 2 in. These wall tiles were, about the year 1327, sold at 6*s.* 1*d.* the 1000; about 1377, at 6*s.* 8*d.*; about 1400, at 5*s.* 8*d.*; and about 1420, at 6*s.* 8*d.* About the year 1490, brick, intermixed with ornaments of stone, became the most fashionable manner of building; and from this period the Flemish wall tiles have continued in use until the present time, under the name of bricks.

The different kinds of masonry introduced by the Romans,

and used in their time by the Britons, were almost lost, though not wholly so, during the unhappy state of the country after the departure of the former people; and their successors, the Saxons, when they were converted to Christianity, understood the art so little, that the few churches and monasteries of any note which they erected were built by foreign masons after the Roman manner. These foreign masons (introduced by the Saxons) followed so closely the system of building which the ancient Romans had previously introduced, that even the ornaments of their erections were after the Roman manner.

The materials used by the Romans in their walls were such as could be most easily procured near the place where the erection was to be made. In many parts ragstones were to be had, with little trouble, near the surface of the ground; and, in other places, pebbles and flints were procured in abundance, which were used with ligatures of flat ragstones, or with flat baked tiles when flat stones could not be conveniently had. In all cases, however, where stone could be procured of a proper size and quality, it was used for facing the walls, while the middle was filled up with flints and pebbles.

Those quarries whence the builders of after-ages derived their stone appear not to have been discovered by the Romans, as they seldom used any stones larger in dimensions than may be found, in many places, near the surface of the earth. Even after the Conquest, the builders had, at first, to be supplied with large stones from Normandy; but the expense and inconvenience of carriage, and the many churches, and other extensive buildings, which were undertaken when the Normans had fully settled themselves in the country, obliged them to open quarries, where stone could be found, as near as possible to the site of their intended buildings. Where stone could not be found the neighbourhood of an intended erection, and the expense and inconvenience were too great for them to be brought from a distance, wall tiles were made to suit the places where squared stones were generally used; and the other parts were built with firestone, ragstone, pebbles, or flintstone. It may here be observed, that the Norman masons seldom used the soft freestone in buildings, in any part exposed to the weather; and, in all cases where freestone of any description was used externally, it was placed in the work in the same position as it lay in the quarry, which rendered it not only less liable to be split by the weight it had to sustain, but also less subject to be torn asunder by frosts.

The most ancient sort of masonry used in England is that of cement and tiles, as used by the Romans in various buildings. The walls were built with small rough stones mixed with coarse mortar, and with tiles laid at convenient distances to bind them

together, and at the external and internal angles for strength. These bands, which consisted of three or four courses of tiles, were laid through the wall 2 ft. or 3 ft. above each other, and the intermediate spaces filled in with pebbles or ragstones, and cement. This sort of masonry, which, as before observed, was much used by the Romans in this country, is also to be found in other countries which they conquered. Whether this method was used by the Britons, after the departure of the Romans, is uncertain; but it was probably followed by the Saxons; and the Normans had so closely imitated it in their buildings, that the latter have been taken for Roman works. Although the walls of cities built by the Romans were seldom entirely of bricks, or with facings of bricks, or flat ragstones laid in regular courses, having the interior filled in with rough stone, yet many of their principal buildings, both in this country and in other parts of Europe, were executed in this manner. The Saxons followed this method in many of their buildings, where stone could not easily be procured. In Norman churches, also, where large pillars are employed, their outer facings are built in this way, with squared stones laid in regular courses, the middle being filled in with cement composed of mortar and pebbles, or ragstones; and, when the arched or flying buttress was introduced, it was built in this way, as being the strongest and most beautiful method. Where flat ragstones were in abundance, very strong and durable, though not very handsome, walls were formed by laying them in mortar, in such a manner as to bind each other in regular courses through the thickness of the wall: the angles were strengthened, and the arches and openings were finished, with squared stones. This manner of masonry was used by the Greeks and Romans, and it is found in buildings of all ages in England. It is employed in many churches built after the Conquest; and it was used in King's College Chapel, Cambridge, where the joints are found to be set with small black flints.

In the Saxon buildings, and in most of the buildings erected soon after the Conquest, it is singular to observe that the walls, pillars, and arches are built of such small stones, that the courses seldom exceed 7 in. or 8 in. in depth, although large stones could have been easily procured. The latter were seldom used, except for particular parts of the work, or for bases and capitals of pillars; and there are many large churches and lofty towers built entirely of pebbles or flintstones, or sometimes of pebbles and ragstones, where such could be easily collected, except the angles of the walls and the window and door finishings, and other parts which could not well be executed without squared stones.

Another kind of masonry introduced by the Romans, or by

the foreigners brought to this country who built after their manner, was by squared stones being placed on their edges, diagonally, in the wall, and appearing like the meshes of a net; but this disposition of the stones was discontinued for its want of principle, and its want of solidity and strength; the Saxon and Norman masons, therefore, never used it where strength was required, but merely for ornament in the filling in of arches, &c.

The buildings raised with pebbles, &c., by the Normans, which were nearly after the manner of the Saxon buildings, and constructed of the same sort of material, consisted of three kinds. The first sort is that where pebbles only were used; the outsides of the walls being laid with stones, of about the same size, in regular courses, and the angles built with squared stones. The next is where pebbles and rags were used, and the angles strengthened with squared stones 2 ft. high, and 6 in. or 7 in. square, which were tied in the wall by the superincumbent weight of other stones laid on the top of them. The outer shell of the wall was raised to the height of one of these stones, with rags on one side, and pebbles on the other, and the intermediate spaces filled in with cement and mortar; when this was sufficiently dry, the square bond-stones were placed on the angles, and flat ragstones, the height of the bond-stones, formed the next course: the course immediately following was then proceeded with as at the commencement. The third sort of masonry was composed of pebbles and ragstones, laid regularly; and, at every 2 ft. or 3 ft. in height, several courses of ragstone were laid angularly on the wall, in the "herring-bone" manner, as it is technically called. These different modes of building with rough irregular materials presented but a rude appearance; therefore, the small churches and other buildings erected in this manner were always plastered on the inside, and frequently on the outside, with a composition of lime and sharp sand. In many of the structures erected with wall tiles after the Roman manner, the walls, the pillars, and the arches were finished with the same sort of plastering as used for the walls built of pebbles.

From the foregoing remarks on the different kinds of masonry used in this country from the first settlement of the Romans, it appears that there is little difference between that introduced and practised by them, and that subsequently practised by the Saxon and Norman builders, under the denomination of Roman works; and the same modes of building were afterwards used, with only the change necessary to suit the different styles of architecture at different periods. Hence the difficulty of ascertaining the exact age of a building, from the materials employed in constructing it; or of discovering the methods of using the

materials, especially in those buildings erected with new materials before and after the Conquest, when we have no other means to assist us in the discovery.

There was no considerable change in the method of building, from the time it was first introduced by the Romans until the time of Henry II., when great alterations began to be made in the style of architecture. At this time highly polished marble came into use for capitals and bases, and was sometimes used in the shafts of pillars; but about the year 1340 it began to fall into disuse, either in consequence of the labour and expense of polishing, or because it was not of long duration. Though marble was much used in the twelfth and thirteenth centuries, it does not appear to have been used in any way by the Britons, or by the Saxons, before that time, except, by the latter, as tombstones and fonts, and occasionally in the flooring of churches; though they had, in general, figured tiles for this purpose. In the methods of building with stone there were only such alterations made as the changes in the Gothic styles occasioned, from the early part of the thirteenth century until the introduction of Grecian architecture in the time of Henry VII.: but it was within that period that the wall tiles, which were previously made of any convenient dimensions, were formed after the Flemish manner, as before observed. The art of using the Flemish bricks was not, however, well understood by the tilers of that age; nor were they thoroughly acquainted with the Flemish bond (which is the strongest method used in building) until the time of Henry VIII. About this time, or between 1500 and 1540, it was customary to chequer the fronts of brick and stone buildings with flints, occasionally in regular square figures, but frequently intermixed with stone, in imitation of open Gothic work. Buildings in this manner had a neat and pretty good effect. The brick buildings of this time may be known by being chequered with glazed bricks, of a darker colour than the rest of the fronts, which were built of very hard and well-burnt bricks, of a deep glaring red colour. The window-frames and mullions were occasionally of stone; but frequently formed with bricks moulded on purpose, and coated with stucco, to imitate stone.

From the middle to the end of the sixteenth century, the ornaments which were introduced in the time of Henry VII. were frequently imitated in burnt clay, to adorn the fronts of the houses and chimney shafts. At this time the rage for ornament was so great, that Grecian and Gothic ornaments were incongruously mixed; and the practice continued until about the commencement of the seventeenth century, when plain chimneys became fashionable, and moulded bricks were accordingly disused. In this, as well as in the preceding ages, many buildings

were very badly executed; and it was not until after 1625, or in the reign of Charles I., when the arts were revived, that building with brick began to be well understood, and to be well executed, under the superintendence of that great master of architecture, Inigo Jones.

39. New Church Street, Paddington, Feb. 7. 1835.

ART. VII. *A few Remarks on ancient Foundations and modern Concrete.* By CHARLES REED, Esq.

BEFORE I begin to speak of modern concrete, it may be proper to say a few words on the manner of laying foundations among the ancients; for, of all the parts of an edifice, the one of most vital importance is the foundation. Palladio, speaking of foundations, says, "Of all the errors in building, those are the most fatal that are committed in the foundation; because they not only endanger the whole structure, but they cannot be rectified except with the utmost difficulty: the architect, therefore, must take great care to make choice of a good foundation:" and here he shows the extreme importance of practical, as well as theoretical, knowledge in the profession. We may naturally suppose that the original habitations of mankind were of the simplest kind, and formed of caves, branches of trees bent down to the earth, or by some other methods equally simple; but as men increased in civilisation, so would they increase in wants; and wooden structures next followed. For these but little foundation would be required; poles, stuck into the earth, were all that was necessary: but, as mankind made still greater strides towards civilisation, the inconvenience, instability, and perishable nature of wooden buildings became evident, and edifices of stone were erected. Probably the first stone erections were only altars; for in the Scriptures we frequently read of altars being raised, without mention being made of temples. Noah built an altar: and, from the expression *built* an altar, it may, perhaps, be presumed to have been of small stones; for, had it been of but one stone, the expression would, most likely, have been, *raised* an altar, or some word of parallel meaning; as we afterwards see, when "Jacob rose up early in the morning, and *took* the stone that he had put for his pillow, and *set it* up for a pillar:" and from this it may also be inferred the stone could not have been very large, as it had served him for a pillow. After these diminutive erections, some of the earliest and largest edifices are recorded to have been built by the Assyrians; though it is difficult to understand, in the present day, the accounts which historians have transmitted to us of their magni-

tude. Diodorus, speaking of the city of Nineveh, built by Ninus, says that its walls were 100 ft. high, and so thick that three chariots might go abreast; and that there were 1500 towers 200 ft. high. But Semiramis seems, when she built Babylon, to have far outdone Ninus; for the walls of that giant city were 350 ft. high, and 87 ft. in thickness: of these the materials have been transmitted to us, though not the mode of the foundations. Bricks and bitumen were the substances: but all other particulars are denied us, and no remains exist at this day; nay, even the very sites are not with certainty known. In the walls of the hanging gardens more moderate dimensions were used, as they were but 22 ft. in thickness; and, from parts of the context, and the recent discoveries of Rennel, I think we may infer the foundations of these were laid on large stone slabs, thickly covered with reeds and bitumen. These erections are gone by; but the pyramids of Egypt exist, their gigantic sphinxes, their quays, their temples, and their obelisks; so do the great wall of China, and the immense erections of the ancient Mexicans; the accounts of which would have been equally difficult of belief, had they been transmitted to us in the same manner. Of the practical mode of building walls and foundations in Egypt we have not many accounts; for travellers are not generally sufficiently versed in the more professional mode of viewing an edifice, or look at them with a hasty eye; besides, the difficulty of arriving at the foundations of ruins, and the great height, generally, to which the sand, earth, and fragments have raised the ground above the original level, in many instances entirely covering the edifice, further prevent any accurate account of the foundations being given. From the arid nature of the soil and climate, and the great thickness of the walls, foundations were not required to be much more than continuations of the walls above; hence we find, that the foundations have not always a wider spread (technically termed footing) than the superstructure, which was further rendered unnecessary by the immense width of the walls themselves. Cement seems not to have been used, as almost all their temples are constructed with stones, so nicely wrought, that it is unnecessary; although one of the smaller pyramids at Memphis is an exception, being built in only six steps, or ranges, of huge misshapen blocks, and cemented with a very large proportion of mortar, filling up every interstice. The materials of walls and foundations in Egypt are, generally, sandstone, breccia, granite, and brick dried by the sun, but never burnt in the modern way. Deeply is it to be regretted that no Stuart has arisen amongst us, to give more detailed drawings and descriptions of those sublime monuments of Egyptian skill, when so many of the finest structures remain perfectly complete, and

others, with trifling difficulty, might be restored. But, alas! perhaps the edifices of Memphis and Thebes, Meroe and Ombos, Latopolis and Apollinopolis, Luxor and Carnak, in the same city, are doomed to perish for want of illustration; and may only be handed down to posterity like the meagre accounts, in the present day, of Babylon, Nineveh, and other great cities, through Herodotus, Diodorus, Strabo, and others, in so imperfect a manner as to leave a doubt of the accounts, as to what to believe, or what to reject.

Of the earliest buildings in Greece now remaining, the Cyclopean walls of Tiryns, Mycenæ, &c., supposed to have been the same as those mentioned by Homer, are the most prominent, and, perhaps, the most singular. This Cyclopean walling is, probably, what Vitruvius means by the word Antiquum. The walls of the acropolis at Tiryns are 25 ft. thick, with two galleries of 5 ft. each in them: the uses of these galleries can now only be conjectured; but they are not peculiar to Tiryns, as they are met with in the walls of the acropolis of Argos, and other Pelasgic cities. These walls are constructed of large unhewn stones, of all sizes and shapes, 8 ft., 9 ft., 10 ft., and 11 ft., by a proportionate width, without cement, and the intervals are filled up with smaller stones. The walls of Mycenæ seem to have been of later date, judging from their being constructed of stones better shaped. These walls are but 21 ft. thick. Generally speaking, the more modern the wall the better constructed, and the thinner. The foundations of these, as of all Cyclopean walling, are formed of stones much smaller than the superstructure; a practice not consonant with stability, or with the practice of the moderns. At Drymæa, Panopeus, and Eleutheræ, the walls are of still later date, being formed of parallel courses, though with larger stones here and there; and being but 9 ft. and 8 ft. thick, though without cement, and little care seeming to have been used in making bonds, or ties of any kind. This is worthy of notice; as in the walls of the temples of later date much attention was paid to this mode of structure; and though these, also, were built without cement, the want of it was made up by a liberal supply of metal cramps. In Cyclopean walling, generally speaking, cramps were not used; though the walls of the Piræus are an exception, being 8 ft. thick, and strongly cramped. All these walls rendered any very great art unnecessary in their foundations, their breadth being sufficient to support them; but more care seems to have been bestowed upon the foundations of later edifices, as we learn of the Temple of Diana at Ephesus, which being rather extraordinary, is here given in Pliny's own words: — "In a marshy soil they placed it, that it might not be affected by earthquakes, or subject to any rendings; and further, that

they might not lay the foundations of such a vast pile upon a yielding unstable bottom, they formed a stratum of pounded charcoal, covered with fleeces of wool. The length of the whole temple was 425 ft., the breadth 220 ft., the columns 127 (in number), the height of each 60 ft." What would our modern builders think of a marshy soil, with fleeces of wool for a foundation? whatever they might think of the more common material of pounded charcoal. Here I will mention a species of walling much in use among the Greeks, that is, the style called emplectron, formed of two external casings of stone, and having the interior filled up with rubble-work and mortar; the heading stones generally tailing through, so as to form a good transverse bond. This rubble-work is the only kind of material, in use among the Greeks, bearing any resemblance to our modern concrete; but it was not, I believe, ever used as foundations. Among the Romans a far greater variety of materials was used in foundations than among the Greeks, who depended much on their immense blocks of stone, their admirable nicety of joint, and the ponderous thickness of their walls; which, in all cases, even those of their temples not excepted, were of immense thickness: the walls of the temple of Apollo Didymæus may be mentioned as an example, being 8 ft. 10 in. in thickness.

We learn from Vitruvius that two parts of puzzolana to one of mortar, thrown into the fosse, formed a common foundation among the Romans, being thrown in like our concrete, and making a mass which became so indurated, that scarcely any thing less than an earthquake could disturb it. This is partly to be attributed to the great quantity of iron in it decomposing the water, as is found in all cement containing any great quantity of argillaceous earth and iron. The component parts of puzzolana are about 60 siliceous earth, 20 of argillaceous, 5 calcareous, and 15 of iron. Artificial puzzolana is sometimes made of forge ashes and earthenware; also broken bricks, tile, and such like, but not equal to the original from Puzzuoli, whence it derives its name among the moderns; it being called terra puteolana among the ancients, from Puteoli, its ancient name. It is most useful in building in water, and was extensively employed by Smeaton in the Eddystone lighthouse.

The Romans also made use of piling to a great extent, particularly in marshy places, where the earth was dug out, and piles of scorched oak and alder driven down into the sound earth, the intervals being filled up with pounded charcoal, and the whole covered with broad stones laid transversely; this they were enabled to make do, from the diminished thickness of their walls; those of their temples, generally, not exceeding 2 ft. 6 in., or 3 ft. Rubble-work, grouted with hot lime and sand, was also very extensively used in the same manner as the puzzolana;

that is, it was thrown into the foundation fosse, and allowed to remain a sufficient time to become indurated; the superstructure being then carried up upon the upper superficies. This kind of foundation seems to have been principally used where large masses were to be erected, such as the foundations of towers, obelisks, columns, and piers of aqueducts; in the latter it often served as foundations and core, as in the case of the Claudian Aqueduct at Lyons. The facing was the *opus reticulatum* of Vitruvius; that is, the ashlar stones were laid diamondwise upon their arrises, making the ends appear like network; whence its name *reticulatum* among the Romans, and *dictyotheton* by the Greeks. In these piers the bottom was of brick, and then the ashlar was carried up a foot or two, and the central portion filled up with rubble, sand, flints, &c., grouted with liquid mortar. The Romans were ever especially careful to well beat up and mix their mortar; and were so particular respecting this, that, if possible, they carefully avoided the action of a burning sun, considering it nearly as hurtful as that of frost. To this care is owing the extreme solidity of their structures, and not to any secret, or superiority, in the making of their mortar.

Among our Saxon progenitors the same mode of using rubble foundations was put in practice, having the Roman method, doubtless, transmitted to them by the aboriginal inhabitants, or discovering it from Roman remains existing in their day, but which have now perished; though, among the numerous Roman *castra stativa* then erected, a few still remain; the most perfect being that at Richborough, the walls of which are built externally of flint and brick, with loose sand, stones, lime, &c., filling up the centre. It was the opinion of Sir Christopher Wren, when taking down the old Roman cathedral, the predecessor of the present one of St. Paul's, that it was built on the remaining foundations of the more ancient Saxon church, as he found them composed of rubble and very hard mortar, well mixed together. We have not, in Britain, any walls equalling in thickness the Cyclopean walls of Greece and Latium; but, nevertheless, we have still some remains that will not disgrace the name of our ancestors, in point of stability, or ponderosity of walling. The Roman walls of Richborough are 13 ft. in thickness; those of Porchester Castle are 12 ft. thick; Norwich Castle, 11 ft.; and Conisborough, 10 ft.; all of which are of the Saxon era. Of the Norman era, we have the keep of Tunbridge Castle, built by Richard de Clare, in the reign of William Rufus, 12 ft. thick; the keep of Rochester Castle, built by Gundulph, 12 ft. thick; and numerous others, some of greater magnitude, and decreasing down to 7 ft., as at Lewes Castle, and even of less dimensions. Many of the ancient walls were formed of a species of concrete, by having a framework, consisting of two vertical ranges of

boarding a few feet high, and as far apart as the intended thickness of the wall: into it were thrown the usual components, of sand, flint, pebbles, and other stonework, and hot lime; which, after a short time, becoming sufficiently hardened, the framework was removed, and another portion added in the same way. This was principally used in the low fence walls surrounding rich abbey gardens, but was also employed in more important works, as at the walls of Aldborough church, which are supposed to have been done in this manner, and are formed of round stones and cement.

Piling, among our ancestors, was also much used, Pevensey Castle being on large piles, which are covered with immense slabs. Timber was often worked into the walls of foundations, as we see at Tunbridge Castle, in the manner of modern bond. Ingulphus, speaking of the monastery of Croyland, Lincolnshire, which was built on a marshy foundation, says that piles of oak and ash were driven down, and earth and sand well rammed into the interstices.

Numerous other methods, too long to mention here, were used in Britain and other countries; such as the fine system of piling in Venice, and, also, in Holland, where tarras filled the intervals; the method, so generally adopted among the Italians, of planking; and the use of slabs in other parts of Europe. Of late years, a new method, or, at least, a remodeling of an old one, has been adopted, to which I am now about to call your attention, having had peculiar opportunities of observing its properties and effects. I allude to the composition called concrete. The components of this are, coarse rounded pebbles, about the size, and somewhat of the shape, of a chestnut, which have always with them a portion of very coarse sand, dug out of the bed of the Thames, and called Thames gravel, and good stone lime; the whole being well beaten up, and thoroughly intermingled together. This is thrown down from a height of 8 ft. or 10 ft., but should never be less than 8 ft., into the foundation, which is dug out to the width the concrete is intended to be. During the operation of filling it in, men should be employed to tread, or puddle, this down; and on no account should a layer of more than 12 in. in depth be thrown in at once. This, in a short time, becomes so indurated as to be as hard as the firmest rock; other layers, of the same thickness, are then added, until the required depth of concrete for the foundation is attained. Much controversy has existed, as to what should be the relative proportions of lime and Thames gravel; and, from the result of a series of experiments, which have been tried by the first practical men of the day, I am enabled, with some little confidence, to say, that the best proportions are, one ninth of good Dorking or Meastram stone lime, and eight ninths of Thames gravel;

in which will necessarily be a portion of very coarse sand, of the size of fine gravel. But, in addition to this, I think, perhaps, if another ninth of common sand were added, the concrete would be firmer. Calcined limestone, when wetted, falls into powder, and becomes a stiff paste, called hydrate of lime, which, whether in the shape of mortar, or grout, in the process of drying, crystallises, leaving minute apertures between the different sets of crystals. Now, if any considerable weight rests upon this, the stalactiles, by the destructive force, break; and that which was before composed of numerous crystallisations, with interstices between them, becomes a powder, neither so hard, nor durable, as it ought to be; but, if the interstices were filled up with particles of sand, and the lime, instead of forming crystals, were only used for its legitimate purpose of cementing these numerous particles together, a firmer mass would be produced, as it would contain a greater quantity of one of the hardest substances in nature, silex, instead of lime; sand, also, has the property of not increasing its bulk, whatever quantity of moisture may be applied, a remark not applicable to calcareous substances. As large pebbles form the great portion of the solidity of the concrete, so, also, should the spaces between each pebble, instead of being occupied by comparatively soft lime, be occupied by substances equally solid with the pebbles; which can only be accomplished by the addition of minute, yet solid, particles, such as sand; whilst the lime is only used to cement the various bodies together, and so to form an aggregate sufficiently indurated to sustain the weightiest structures. Great care should be taken that all argillaceous, or earthy, matters should be carefully washed away, and the whole well beaten up when dry, and small quantities gradually added until of due consistence; in all which circumstances consists more than one half of the excellence of the whole material. Of all the sands used for this purpose, pit sand is the best; and it should feel dry, and crackle when abraded between the fingers. River sand is the next; but white sand, or that from the sea, should on no account be used; the angles of the particles of sea sand are broken by constant attrition, and it contains so much saline matter, as to render the whole damp and carious. The superiority over piling, and admirable effects of this invaluable composition, have been fully shown in the Custom House, near London Bridge, where this kind of concrete was extensively used, when the former failed. It has, however, been more extensively used in the foundations of the New Westminster Bridewell, Tothill Fields, by its very talented architect, Mr. Robert Abraham, than in any other building I know of; the site of this building having been formerly a marsh. I have known it used successfully in large airing yards, where the whole area was covered with it to the depth of several feet,

and the superficies spread over with gravel. It would, also, be useful for cores of piers, and abutments to bridges. For the Tyro in architecture, I will just add a method, by which he may know how to find, with tolerable accuracy, the necessary quantity of concrete which should be used to any particular wall, or building. For the depth, to every four courses of brickwork above, or every foot long, one inch in depth of concrete; and let the breadth be the thickness of the walls beyond the footings on each side.

Of all the systems for foundations, ancient or modern, this, I think, will be found to answer the best, for stability, freedom from dampness, economy of time and labour, and simplicity of execution.

December, 1835.

REVIEWS.

ART. I. *An Historical Essay on Architecture.* By the late Thomas Hope. Illustrated from drawings made by him in Italy and Germany. Royal 8vo, 2d edition. London, 1835.

(*Continued from* p. 34.)

CHAP. XIII. *Derivation of Persian, Mahometan, and Moorish Architecture from that of Byzantium.* The artists and men of learning of Constantinople were sought for, while that city was the most civilised of Europe and Asia, by every other people, as well by the old Asiatic monarchs as by the new sovereigns of Europe. Greek architects were in great request with the Persians, whom they taught to construct the arch and the cupola. Metrodorus, a Persian architect, established himself at Constantinople; and another Persian architect was employed by Justinian the Second. Hence the reciprocal influence exerted over each other by the taste of Byzantium and that of Persia.

The Arabs did not imitate the Greek architecture, until they had adopted the religion of Mohammed: —

"As soon, however, as, under the Abasside kaliphs, they began to exchange the asperity of undiscriminating bigotry for the elegancies of cultivation, they, too, like the Persians, put themselves under the tuition of the nation whose preeminence all others of the middle ages acknowledged. Grecian astronomers, mathematicians, and physicians, Grecian grammarians and linguists, were invited to every Saracenic court; and we have it as an historical fact, that about the year 820 the kaliph Al-Mamoun-Abdallah, son of Haroun-al-Raschid, applied to the emperor of Constantinople for the best Greek works, to be translated into Arabic and read in the Arab colleges of Cufa, of Basra, of Cairo, Fez, Maroc, Tunis, Tripoli, and others." (p. 147.)

"Indeed, the Saracens and the Moors, like the Persians, not only copied Grecian art, but employed Grecian artists. In the same way that the Emperor Justinian invited a Persian architect to Byzantium, Abderahman, king of Cordova, called a builder from Byzantium to Spain; and, in fact, wherever

the Saracens successfully established their dominion, every edifice for use and for elegance, the medrassé, the mosque, and the mausoleum, the palace and the pavilion, bespeak, in their fundamental features, the imitation of the two nations to whom they chiefly owe their later culture — of the Greeks and the Persians.

" That other swarm, completely barbarous in its native hive — that branch of the great Tartar race called the Moguls, who, later again, overran Persia and made Constantinople tremble — no sooner had established its empire in India, and begun to cultivate the arts of peace, than it also seems, through Persia, to have derived its artists and its models from the common source which supplied all the regions of Islamism. Seeming to hold in contempt or abhorrence the heavy indestructible pagoda of the idolatrous native, the Mogul princes of India, instead of the patterns immediately under their eyes, imitated in their mosques and mausolea the airy arches and the lofty cupolas of the Persians and the Greeks.

" Thus, on the wings of Mohammed's spreading creed, wafted from land to land by the boundless conquests of his followers, the architecture of Constantinople, extending one way to the farthest extremities of India, and the other to the utmost outskirts of Spain, prevailed throughout the whole of the regions intervening between the Ganges and the Guadalquivir: in every one of the different tracks into which it was imported still equally different from that of the aborigines or early possessors; — in Asia Minor, from that of the ancient Sardis and Ephesus; in Egypt, from that of Thebes and Memphis; in Persia, from that of Istakar and Nacksi Rustem; in India, from that of Gnatio and Benares; and in Spain, from that of Saguntum, by the side of which it rose; and in each, still resembling its own more remote ramifications in every other country enumerated, or its common stock in the mother soil. Thus, while in none of the various and distant countries here named, we observe, previous to the adoption of Islamism, the slightest approach to those inventions, the pride and the stay of architecture — the arch and the cupola; in all of them alike, on the very first settling in them of the Mohammedans, we see these noble features immediately appearing, from the application of Greek skill, in the full maturity of form they had attained among themselves." (p. 148—150.)

Chap. XIV. *Derivation of Russian Architecture from that of Byzantium.*

" To spread like rays of light on every side, it only remained for the Constantinopolitan architecture to penetrate the Sarmatian tribes, which on the north-east of the Byzantine empire reach almost from the Black Sea to the White: and among these, also, it soon made its way. The Czars, or Cesars, of Russia, who styled themselves the representatives of the emperors of Constantinople, who derived from the Greeks of Byzantium their literal characters and their creed, also took from them their architecture." (p. 152.)

" When from Novgorod the seat of the empire was, by Ivan, transferred to Moscow, that city received at the hands of its prince a new cathedral, which has since again been demolished: he also constructed a citadel, called Kremlin, and a lesser church, in remembrance of the transfiguration, which still subsists. Of these, as of all the other churches erected in Russia while the Grecian empire lasted, the architects were Greeks. When the fall of Constantinople caused Italians or natives to be employed, the original style of the country continued so far to influence their designs, as still to make these present the Greek exterior, in the façade, adorned with enamelled tiles; and the Greek distribution in the cross, with four equal ends, crowned by a large central, and four smaller surrounding cupolas, of bulbous form, from between which shot forth steeples, shaped like the minarets of Cairo, of Isaphan, and of Delhi: and as the cathedral of every Russian city resembles the Mohammedan mosque, so the Gostinoi Dvor — the square market-place — of every city,

with its double range of arcades, resembles every Eastern caravanserai or khan, and marks, like the former, the relationship borne by the Russian architecture to the Arab, the Persian, and the Moorish, and its common filiation with these from that of Constantinople — whose ramifications, extending alike to the north of Europe and the south of Asia, the Indian and the Atlantic Ocean, enable one, in the market-place of Novgorod, to fancy oneself in the Meidoun of Ispahan; in the cathedral of Kieff, to acknowledge relationship with the mosque of Cairo; and in the Kremlin of Moscow, to recognise the minarets of Agra and of Delhi." (p. 156—158.)

(*To be continued.*)

ART. II. *The improved Builder's Price Book, containing upwards of Eight Thousand Prices, founded upon actual Calculations, carefully digested and corrected from the present Price of Materials and Labour; also the Workman's Prices for Labour only; the most preferable Mode of Measuring pointed out; and upwards of Two Thousand useful and important Memorandums and Tables; together with Extracts from the Building, Paving, and Chimney-Sweepers' Acts, and Tables for purchasing Leases, Estates, or Annuities.* By W. Laxton, Surveyor. Tenth edition, with considerable Additions and Alterations. 8vo. London, 1836. 4*s*.

WE are glad to see another edition of this excellent work; generally, we believe, allowed to be decidedly the best of the different London Builder's Price Books.

ART. III. *Plans, Elevations, Sections, Details, and Views of the Cathedral of Glasgow.* By J. Collie, Architect. Part I. consisting of five lithographic plates. Extra fol. London, 1835.

THIS will be a valuable work, more especially if Mr. Collie gives the details and the ornaments, many of the latter being curious, and some of them very original; at least if our recollection of this sublime fabric does not deceive us. We cannot better recommend the publication than in the words of Mr. Collie's prospectus: —

"When it is considered that the cathedral at Glasgow is the only ecclesiastical building in Scotland, of any extent, which escaped the ruin in which the monastic establishments throughout that country were involved at the period of the reformation, its propriety and fitness as an object of illustration will be sufficiently obvious, independent of the fact, that this cathedral is one of the finest examples of early English Gothic architecture now extant. Although Glasgow Cathedral possesses architectural beauties of the very highest order, and although her crypts are by far the most unique and magnificent in the kingdom, and have been invested with such romantic interest by the great master-spirit of the age, yet these beauties are comparatively unknown, no successful attempt having been made towards their delineation — a circumstance the more remarkable, seeing that the cathedrals throughout England have been so fully and splendidly illustrated. From these considerations, and the recent appearance of Mr. M'Lellan's admirable

history of the cathedral, as well as the interest which has been excited by that gentleman's zealous exertions in furtherance of the restoration of this structure, and the completion of its original design, the author has been led to attempt the publication of the work now contemplated, convinced, that, if delineated and got up in a manner worthy of the subject, it will recommend itself to an enlightened public. The object of the work will be, to furnish, along with a short descriptive letter-press, a series of correct and elegant lithographic drawings, consisting of plans, sections, elevations, and details, both of the mouldings and foliage; together with perspective views of the fabric, from different points of the interior and exterior, all of which will be comprised in between 30 and 40 plates; two of which, the south elevation and the longitudinal section, will be upwards of 4 ft. in length."

Art. IV. *Literary Notices.*

Domestic Architecture is preparing for publication by Mr. Williams. The author is P. F. Robinson, Architect, F. S. A. and F. G. S., Vice-President of the Institute of British Architects, author of the new *Vitruvius Britannicus*, and other works. *Domestic Architecture* will appear in parts, and will illustrate various buildings designed and executed by Mr. Robinson.

La Alhambra is preparing for publication, and will consist of a selection of plans, elevations, sections, and details of this splendid specimen of Moorish architecture, so unexampled for the purity of its ornaments and richness of its colouring, from drawings, taken during a residence of several months in the Alhambra, by M. Julie Goury (deceased), and Owen Jones, architects, drawn on stone by Owen Jones, and artists under his direction, accurately printed in colours.

The Continuation of Pugin's Works on the Architecture of the Middle Ages, by Thomas Larkins Walker, architect, will be published in parts; the first appearing in June, 1836.

MISCELLANEOUS INTELLIGENCE.

Art. I. *Domestic Notices.*

ENGLAND.

The Institute of British Architects held a meeting on Monday the 5th inst., S. P. Papworth, Esq., V.P., in the chair. Amongst the presents announced as received, were two medals in gold, and one in bronze, from the Royal Academy at Berlin; and a copy of the works of M. Hansteen, the celebrated Danish architect, with a medal from the Royal Academy at Copenhagen. There were also on the tables 120 specimens of the different kinds of marble used in the buildings of ancient Rome, presented by T. L. Donaldson, Esq., with the capital of a triumphal arch from the same city; a marble bas-relief, being a fine specimen of the art of monumental sculpture; a manuscript copy of Sir John Soane's *Lectures*, and several medals and casts. Mr. Robinson, one of the vice-presidents, read part of an *Essay on Concrete*, which had been forwarded in consequence of the offer of a premium, and to which the council had awarded the prize, subject to the approbation of the members; and Mr. Fowler also read a series of communications from Messrs. Smith, extensive builders in Scotland, in answer to the queries issued by the Society. By these gentlemen the first chain-foot suspension bridge was erected, in 1817, over the Tweed in Roxburghshire, the span being 261 ft., at an expense of 560*l.* Prior to this, a wire-bridge had been erected in Selkirkshire, of 100 ft. span, at an expense of 25*l.* The secretary reported that the balance in the

treasurer's hands now amounted to 172*l.*, in addition to the funded property of 1,100*l.*; and that a donation of 10*l.* had been received from Mr. Leverton, in aid of the foundation for travelling students. An eminent architect from Munich was present, and was elected a corresponding member. — *M. C. Jan.* 6. 1836.

Kent. — *Herne Bay New Chapel.* — A new chapel of ease, in the pointed style of architecture, has recently been completed at Herne Bay; the front and sides are in imitation stone, and the back front is in brick. The only novelty displayed in this erection is in the front; over the principal entrance is a niche, containing the figure of our Saviour bearing the cross; the figure is in cement, and the cross wood. — *Tyro. Wilmington Square.*

Somersetshire. — *Clifton Suspension Bridge.* — It has, at length, been determined by the trustees of the proposed suspension bridge across the Severn, at Clifton, to proceed with the undertaking. The design to be adopted is that of Mr. Brunel, with some new suggestions. — *Id.*

Art. II. *Retrospective Criticism.*

Censor's Answer to Mr. Perkins. (p. 42.) — The observations of Censor on the warm-water apparatus of Mr. A. M. Perkins, appears to me to make part of those numerous misstatements, which, either through ignorance or through intention, have so often been put forward by those who have written on the subject; and I am surprised that Censor, having, as he thinks, proved "that Mr. Perkins knows extremely little about the principle upon which his system is founded," should imagine his ingeniously contrived observations will remain unanswered, because he "is completely sick of the subject."

All persons connected with buildings are well aware that a warming apparatus in our public buildings, and in the houses of our nobility and gentry, is in very great request: but the public may not generally know that the providing of them is a business of very great extent, and that it is in the hands of a few monopolists, who are interested in making every exertion to put a stop to any ingenious contrivance, that is capable of producing, at half the expense of any of their own costly apparatus, greater and more certain effects, and upon better and more simple principles. I have always paid considerable attention to this subject, and, during the time I have been in the profession as an architect, I have had opportunities of witnessing the effect, in some of our largest public buildings, of the numerous contrivances introduced for warming them, on the various principles of steam, the circulation of hot water, and the pernicious one of heated air. I will say nothing of the latter system, and merely observe that the excellent, though costly, steam apparatus for warming buildings is now little used; principally, through the constant failures of those put up by unprincipled persons upon cheap terms. The warm-water apparatus has now deservedly become the favourite mode of warming buildings, and it is introduced extensively both in our public and private works. I have seen several of them applied in different buildings. The first I had an opportunity of witnessing consisted of a collection of hollow iron tablets of about 3 ft. 6 in. square, and 3 in. thick, placed upright, and connected together at top by a pipe conveying the hot water from the boiler into them; and at the bottom, by a similar pipe conducting the water back to the boiler to be reheated: as this apparatus, suited only for the interior of a great room, was placed in a situation it certainly was not fitted for, it proved a failure, was taken away, and replaced by Mr. Perkins's system of inch tubes, which was better adapted (as it has been since sufficiently proved) to the situation. It has been a favourite aim with most of the inventors of these systems, to have as much warm surface in their different contrivances as possible: in some, large flat tubes of 1 ft. high by 2½ ft. thick, have been used for the circulation of the hot water. I have seen some

of this kind in use with leakage at every joint; which, but for the use of basins and pails, would have flooded the floor of every apartment in which they were placed. Censor would wish us to believe that the 4-in. tube of the old system gives out a greater quantity of heat than the 1-in. tube of Mr. Perkins. The small quantity of water in the latter apparatus, circulating very rapidly, keeps the pipes at a very high temperature; while the large quantity of water contained in the boiler, and in the tablets of the former, together with the diameter of the pipe itself, prevents the water from ever reaching the boiling point, or being carried with good effect to any great distance. With regard to Censor's remarks on the effects of the bends and turns of the pipes, they merely illustrate some of the difficulties attendant on the "ordinary open apparatus with tubes of 4 in. diameter;" and they have little or no application to Mr. Perkins's system; the apparatus of 4-in. tubes being incapable of forming an ascending column of any great height, and the circulation being principally horizontal. In Mr. Perkins's apparatus, at least in all those that I have had an opportunity of inspecting, the tube containing the ascending column of warm water proceeds directly from the furnace, without, if possible, a single turn or bend, to the highest point of the house to which the warm water has to circulate, and where the expansion tube is generally placed; thence it descends through the numerous coils placed in the different apartments, the tube having then, very probably, from 50 to 100 bends, twists, and turns, at right angles in them." That this is the arrangement of pipes in Mr. Perkins's apparatus is open to any person's conviction. At the British Museum, the print room and the bird room are warmed by two pedestals containing Mr. Perkins's pipes. The furnace is 50 ft. below the floor of these rooms; and the tube containing the ascending column of warm water rises perpendicularly, without a single "bend or twist," to the highest part of the pedestal; it then descends through the coils to the furnace. The different systems of warm-water circulation are more or less suited to particular situations, and I am not going to pass a sweeping censure on all but the one I most approve. I am perfectly aware that the system of 4-in. pipes has its advantages. Mr. Sass of Charlotte Street, Bloomsbury, has one in his study and adjoining apartments, with which he is perfectly satisfied. The room in which I am now writing is warmed by one of Mr. Perkins's systems; it has been in action three years, and to say it merely pleases me is insufficient; my warmest praises could not repay Mr. Perkins for the comfort I have experienced for the last few weeks alone in my office, and in every part of the house where his pipes are present. To-day, the 4th of January, the weather is mild, the temperature in the open air is 48°; the fire in the furnace has been kept low, yet the thermometer opposite to me indicates 66°, and I am removed 30 ft. from the furnace, both in length and height. During the last few cold weeks the temperature of the same room was near 60° at 9 o'clock in the morning. There has been no leakage from any "defective joint or joints" since the apparatus was left by Mr. Perkins, a few weeks after it was first introduced; indeed, it is difficult to imagine how one can take place, the joints being formed by a right and left hand screw within a nut, and screwed so tight that one pipe makes an indent in the other. I am not alone in my approval of Mr. Perkins's system: the profession generally are in favour of it; and Sir John Soane, who is not a person to give his judgment hastily on any subject, has introduced it in his museum; and, when a written application was made lately to him, enquiring as to its success, I am informed that he declared in answer, that, among the numerous contrivances for warming that had been introduced in his museum, the present was the most successful, and had given him the most satisfaction. Sir Robert Smirke has likewise applied it to his office, and I believe in some of his large public buildings. In a valuable work lately published, some quotations from which appeared in the *Architectural Magazine*, and which your recommendation, accompanying the quotations, induced me to procure, Dr. Coombe's *Principles of Physiology* (see vol. ii. p. 460.), I found nearly three pages devoted to the description and recommendation of Mr. Perkins's

apparatus, and I have since learnt that several gentlemen of the medical profession have given similar opinions in its favour.

There is one remark made by Censor which, at least, I did not expect from him; it is, the danger which would ensue, if the water within the pipes of Mr. Perkins's apparatus should freeze in cold weather, &c., &c. That water will freeze in pipes in cold frosty weather is sufficiently well known; the simplest housekeeper in London protects the water pipes in his area under such circumstances. In the depth of winter, when the warm-water apparatus is more particularly in use, the fire in the furnace ought to be made up late at night, and renewed early in the morning, and never suffered to be wholly extinguished: if it should so happen that the apparatus for a few days is not required to be used, a cock placed in the lowest line of pipe will draw the small quantity of water off in a few minutes. I will not allow, supposing a 1-in. pipe should burst from such a cause, that the damage is "more costly to repair" than if the same happened to a 4-in. tube, or an enclosed tablet belonging to any other system; and they are all equally exposed to the same neglect.

I will only add that, whatever Censor's opinion of Mr. Perkins's apparatus may be, its inventor deserves the thanks and patronage of the community, for an apparatus for warming buildings, so admirable in its effect, so easy of introduction, and at the same time, from its moderate cost, so completely within the reach of every moderate income. Let Censor praise the ordinary systems in use as he may, he cannot add to any of them the latter recommendation. — *An Architect. London, January* 4. 1836.

Candidus on Scrutator's Remarks. (p. 47.)—What meaning Scrutator attaches to the expression "bandbox remarks," I do not exactly know; however, as that mysterious epithet is coupled with the sufficiently intelligible one "superficial," let its precise meaning be what it may, it is, obviously, the reverse of complimentary. Neither can I feel particularly flattered by Scrutator saying that I am precisely the sort of person he should call an *artist*, that title being, according to his vocabulary, no better than one of reproach, — at least in architecture; so that my chief consolation is, to learn from him that it applies equally to four fifths of those who style themselves architects. Still, after all, he has now rather increased than solved the difficulty, evading a direct reply to the point in question, which is, how one "who does not properly understand his profession" can, on that account, be entitled to be designated "an artist," by way of distinction from those who do? This is the enigma which Scrutator should have unriddled; or will he go as far as to maintain that architecture is *not* an art, and that those who are most accomplished in it are *no artists?* Be his opinions what they may, his expressions certainly imply this; else the distinction he makes is a most extraordinary one, as it confers the more honourable epithet on those whom he considers the least worthy; which is very much as if we should say that those who are only clever versifiers ought to be termed, *par excellence*, poets. Now, to convince Scrutator that, all bandbox as my opinions may be, I am far from being offended with him, I will goodnaturedly assist to help him out of the quagmire of dilemma into which he incautiously has plunged himself, remarking that what he should have said, and what I will presume he intended to say, was that, for want of practical education, such persons as he calls mere artists can only be called architectural draughtsmen; or, had it so pleased him, he might have added, smatterers and empirics in architecture,—persons, in short, who understand little more of the art than what relates to making drawings. Yet it can hardly be denied, that a man may possess very great ability in architectural drawing, without manifesting any talent whatever in architectural *design*, either as to general composition or to detail; whereas Scrutator's words would rather imply that the numerous class he alludes to excel in design, although they are utterly incompetent in other respects. For this reason was it, that I termed his doctrine an extraordinary one, and, unless he choose to explain himself, such I must still consider it to be.

I have again some difficulty in fancying him quite serious, when he states that, of those who actually profess architecture, not one in five properly understands his profession; because, according to him, the not understanding it arises from the want of practical education, which the greater number at least, it is to be presumed, must have received. Does he then really mean to assert that a very large majority of the profession have not been trained up to it? For, if we are not so to understand him, but that by a "practical education" he means much more than a "professional" one, although we may so far admit his doctrine to be correct, it is not easy to devise any remedy for the evils of which he complains: things must be left to take their course; and all that remains to be done is, for those who employ architects, to ascertain beforehand, if possible, how far they are really qualified to act as such.

Scrutator considers me "superficial"; now I really cannot return the compliment, for his meanings lie so very far below the surface, that it is next to impossible to come at them, or even to guess at what they really are. Instead of styling him superficial, I give him credit for being exceedingly profound. But I do not think it is exactly fair in him to give as a *quotation* what I never penned; and, if he will read over again my remarks at page 469. (Vol. II.), he will there find no such expression as what he has placed between inverted commas, viz. "the practical part of the professional qualities of an architect might be divided from the art of design." Admitting that this does not vary materially from the substance of my remarks, it seems to colour them somewhat differently, since my observation was to the effect that it might frequently be better, were two architects to be associated in the same work, and mutually to give each other the assistance of their respective talents.

This Scrutator considers a preposterous idea, not better than "nonsense," and proceeds to prove it so by an illustration, which is so *mal-à-propos*, that it supports my argument much better than his own, and I, therefore, ought to feel grateful to him for supplying me with it. Is there not in the medical profession exactly that kind of cooperation between the surgical practitioner and the physician, which I ventured to suggest for architecture. Does the physician undertake to operate on a patient by cutting off a limb? Again, is he not called in after a patient has been prescribed to by an apothecary? Why should not the same individual be perfectly competent to act in both capacities, or wherefore should the practical part of surgery be divided from the art of prescribing? Nay, are there not those who confine themselves exclusively to a single particular branch of practice; for instance, accoucheurs, dentists, aurists, and oculists; and, as to the system of cooperation, to such extent is it carried in the medical profession, that, instead of one doctor and apothecary being thought sufficient for a single patient, it is frequently deemed expedient to have the attendance and consultation of two or three doctors at the same time: which, according to Scrutator's doctrine, must be a truly terrible business indeed; for what else can they all be but bunglers, who do "not properly understand their profession," or else what need of so many?

In saying that to one architect might be confided all that relates to the general scheme and artistical effect, I did not thereby intend to assert that he was to be utterly ignorant of construction, and of the *anatomy* of a building, and to design, without considering how the edifice was to be put together; but no more than that, like the physician, he might leave his professional colleague to operate properly in his peculiar department, and to take care that no inconvenience should ensue from the inexperience of the other in purely practical details.

And now, the only ill wish I have to express for Scrutator is, that he will have no occasion to summon any of the medical profession to his aid again, but be able to keep himself out of their clutches all the rest of his days. — *Candidus.*

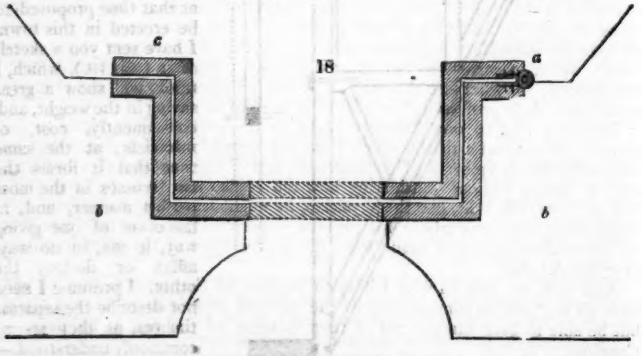
Mr. Hakewill's Pamphlet on Elizabethan Architecture. (Vol. II. p. 369.) — In your review of this work, you mention that Mr. Hakewill offers a few remarks on the rebuilding of the Houses of Parliament, in which he proposes

that only architects eminent in their profession should be allowed to compete. Now, if our architects had gained their eminence by ability alone, unaided but by their own exertions, I should consider that there would not be any objection to this mode of limiting the competing candidates; then again, if these eminent architects possess real merits, surely there cannot be anything to fear from young architects, architectural draughtsmen, or others, whose names are unknown in the architectural world. In my opinion, an open and fairly conducted competition would be the only means of trying the talent of the country; and to insure a fair decision, let professional men be employed as judges, which will be a sure means of preventing favouritism; there being too much jealousy in the profession to allow of anything of the kind. — *Tyro. Wilmington Square.*

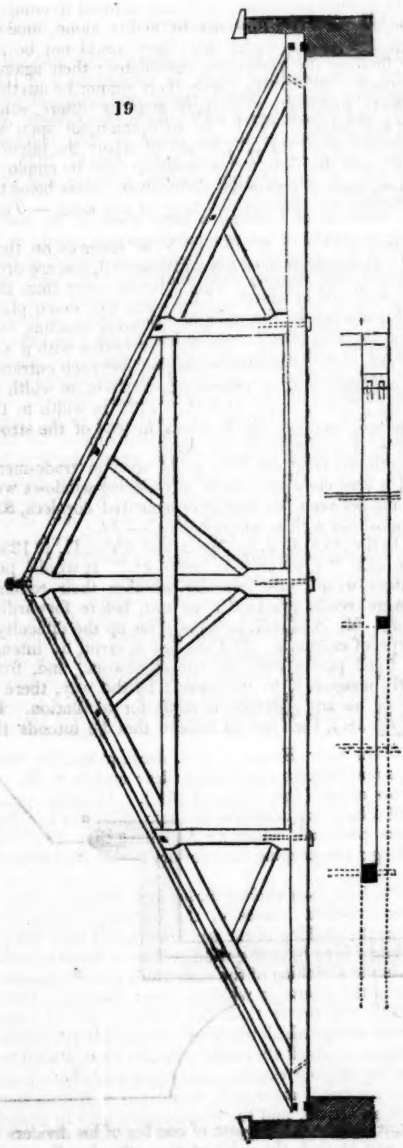
Gin Temples of the Metropolis. (Vol. I. p. 166.) — Your remarks on these edifices have been verified. Other tradesmen have ornamented, and are ornamenting, their houses, and, generally speaking, with a better taste than that displayed in the temples, in which not much improvement has taken place. You may still see, in all parts of the metropolis, large pilasters standing over entrances, and, in some instances, where there are two entrances with a window in the centre, you may observe a large pilaster hanging over each entrance, and one over the window opening; and, in others, pilasters 6 in. in width on the ground story, supporting pilasters of not less than 14 in. in width in the one-pair story. This is, indeed, reversing the business, instead of the strong being made to carry the weak, it is completely *vice versâ*.

Examples of the last-mentioned error are often to be seen in tradesmen's shops; another error, and a very common one, is introducing windows with architrave mouldings, &c., and between the stories ornamented cornices, &c., and then crowning the composition with common coping. — *Id.*

Waterproof Casement. — In the *Arch. Mag.* for March last (Vol. II. p. 133.), Mr. Saul gives us what he calls "a waterproof casement." It would, perhaps, be well if contributors would first consider whether their communications or suggestions were really practicable or not, before forwarding them to you for publication. Mr. Saul will, perhaps, clear up the difficulty I am in regarding his waterproof casement. If I am not in error, he intends the outside frame to be fixed permanently in the stonework, and, from the engraving, we may fairly imagine it to be glazed: by the way, there is no mention made whether or no any provision is made for ventilation. By showing a hinge as at *a* (*fig.* 18.), I am led to believe that he intends the



inside frame to open. Now, if he places the point of one leg of his dividers in the centre of the hinge at *a*, and extends the point of the other leg diagonally across to the opposite internal angle, he will find, by describing an arc from



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the centre (*a*), that the diagonal from *a* to the opposite internal angle is longer, by, perhaps, three inches, than the distance from *a* to *c*; consequently, the inner frame is locked up, and the casement may be, for aught I know, both watertight and airtight too.— *Augustine.*

C. B. W.'s original Design for a Roof (Vol. II. p. 537.) is a combination of what are technically called the king-post and queen-post trusses; but it is not, I think, the best that could be adopted; as in it, it appears that the centre, or king-post, truss derives the whole of its support from the side, or queen-post, trusses. Now, should the queen-post trusses, by any mishap, fail in their destined purpose, the king's would soon be humbled in the dust. The combination of the above-mentioned kinds of trusses, in a one-span roof, occurred to me some few years ago, and was submitted, by me, in a design for the roof of a new church at that time proposed to be erected in this town. I have sent you a sketch of it (*fig.* 19.), which, I think, will show a great saving in the weight, and, consequently, cost, of materials; at the same time that it forms the two trusses in the most perfect manner, and, in the event of one giving way, it can, in no way, affect or destroy the other. I presume I need not describe the separate timbers, as they are so commonly understood.— *Wm. Coles. Winchester, Dec.* 7. 1835.

Art. III. *Queries and Answers.*

Suspension Bridge near Wakefield.—One half of the above bridge suddenly gave way on the 2d inst., with a tremendous crash, in consequence of the breaking of one of the supporting chains. This is the second bridge of this kind which has fallen lately; and I quite agree with your correspondent W. (Vol. II. p. 476.), that some information, as to the cause of such failures, would be highly interesting and useful.—*S. H. P. London, Jan.* 11. 1836.

Park Spring Stone.—Can you, or any of your readers, give me any description of this stone?—*G. B. W.*

A Painting-Room.—I am desirous of building a large room in my back garden, which I intend (being an artist) to use as a painting-room; and, as I have only a lease of ten years of the premises, I am desirous of doing it at the least possible expense, consistent with security from thieves and fire, with the exclusion of heat in summer, and cold in winter. I find, on enquiry, that the cheapest mode is to form a foundation for the walls of brick piers; on these, to lay sills, or joists, and upon these to raise a wooden framework; or, rather, two frames of wood, each filled in with studwork, leaving a vacuity of about a foot between them. The outside frame is proposed to be plastered over with cement, and coloured in imitation of stone; and the inside frame to be plastered in the common manner. As I intend the walls only to be 15 ft. high, this double frame will, it is thought, form a sufficient support for the roof; the floor can be made in the usual manner. Now, what I am in difficulty about is: first, whether such a structure will last during ten years; second, whether, if it lasts that time, I shall be obliged to leave it in repair to the ground landlord, that landlord being a public corporation; and third, whether such a building, and the property in it, can be insured at the ordinary rate. I should also wish to ask the professional readers of the *Architectural Magazine*, whether they can inform me of any cheaper mode of erecting a room 40 ft. long, 20 ft. wide, and 15 ft. high.—*An Artist. London, Jan.* 1836.

In Mr. Hakewill's pamphlet *On Elizabethan Architecture* there occurs the following mistake: in one part (p. 11.), Mr. Hakewill says that the House of John of Padua is the oldest example of Elizabethan architecture, in England, and that it was built in the year 1579; and, in plate 1. illustration 2., is given an elevation of the House of John of Padua, erected in 1567. Now, I should be much obliged to any of your readers who could inform me the real year in which the house was built?—*T.*

Grecian and Italian Tiles.—In your *Encyc. of Cott. Arch.*, p. 25., are two figures (figs. 23. and 24.) of some Grecian and Italian tiles; and, in p. 88. of the same work, there are two others (figs. 163. and 164.). All these specimens are very handsome, but I have my doubts as to their efficacy in keeping out the wet. Have they been tried, and where? And have they answered the most important use of tiling; viz. keeping the roof dry?—*J. H. Bristol, November*, 1835.

Fastenings for preventing Windows from shaking during high Winds.—There are few persons living in modern-built houses of the ordinary description, who have not been annoyed by the shaking of the windows during high winds. The only effectual remedy I know is to have the window frames made of well-seasoned timber; because it is the shrinking of the sash which gives it room to play backwards and forwards in the groove in which it runs: but surely there must be some palliative for this evil better than the ordinary one of using wedges. Are there no brass fastenings which might at once fix the two sashes to each other, and to the grooves in which they run? If there are, I shall be very much obliged if you, or any of your readers, can point out where I can purchase them; and, if there are not, I am sure it would pay a Birmingham manufacturer to get up such an article, and the ironmongers here to expose them for sale.—*A. W. S. Highgate, Jan.*, 1836.